

PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

157th Session (1944-45)

Part 2

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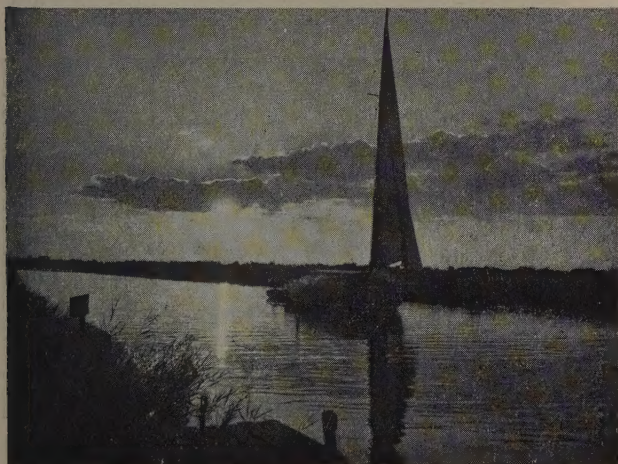
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A. A. Francis

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A. C. Cooper

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PROCEEDINGS OF THE LINNEAN SOCIETY OF LONDON

157th Session (1944-5)

Part 2

PROCEEDINGS OF THE GENERAL MEETING 8 March 1945

held jointly with the Zoological Society of London.

Mr. A. D. COTTON, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 22 February 1945, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Professor G. D. Hale Carpenter, Colonel F. C. Stern and the Carnegie Corporation of New York.

The following communications were read and discussed :—

Mr. G. O. K. SAINSBURY. Photograph of a remarkable specimen of *Pseudopanax crassifolium* C. Koch,—an adult tree with a reversionary shoot on the trunk, showing the linear deflexed leaves which mark the young plant. (See illustration on p. 72.) [Exhibit.] (Shown by the Botanical Secretary on behalf of Mr. Sainsbury; and commented on by the President.)

Prof. J. McLEAN THOMPSON. The study of Plant-behaviourism; a common meeting-ground for future enquiries by morphologists, geneticists, anatomists, systematists, and physiologists alike. (Discussed by Prof. F. E. Weiss, Dr. C. R. Metcalfe, Mr. I. H. Burkill, Prof. F. G. Gregory, Dr. R. S. de Ropp, Dr. R. Melville, Mr. W. C. Worsdell, Dr. B. Barnes, Mr. J. S. L. Gilmour and the President; Prof. McLean Thompson replied.) [Printed in full, p. 72.]



Pseudopanax crassifolium. October 1944. Te Pina, Poverty Bay,
North Island, New Zealand.

**THE STUDY OF PLANT-BEHAVIOURISM; A COMMON MEETING-
GROUND FOR THOSE ENGAGED IN BOTANICAL ENQUIRY.**

By J. McLEAN THOMPSON,

The Hartley Laboratories, the University of Liverpool.

A brief account of the flowering of the Carob Tree (*Ceratonia Siliqua* L.) was laid before the Linnean Society in March 1944, and has been published since then in an abridged form (Proc. Linn. Soc. Lond. 156 Sess. Pt. 2, December 1944).

It was among the purposes of this communication to illustrate how endogenous inflorescences are formed normally and repeatedly upon the ageing branches of some angiosperms which are described commonly as

cauliflorous. As to the Carob itself, it was demonstrated that restricted meristems persist in and above old axillary positions and that both flowering and foliar shoots are formed *endogenously* from these meristems throughout many years.

The facts presented revived an interest in the epicormic state of many modern trees and freed at least some of the phenomena of cauliflory from any conception of abnormality.

One of the features established for the Carob was that single exogenous axillary buds are formed upon all its current shoots. Many such buds quickly give rise to primary inflorescences each of which is subtended by a leaf; others of these buds initiate foliar shoots of moderate initial length. Thus primary inflorescences and foliage are intermingled, season by season, in the general canopy of a Carob Tree.

It was shown further that the stumps of the primary inflorescences now mentioned come gradually to assume positions well-removed from their related leaf-scars; that this displacement is due entirely to the growth-activities of the axillary meristems; and that these meristems bear neither accessory exogenous buds nor other superficial organs of any kind throughout their later life. On the other hand, one of the major results of their prolonged activity is a broadening and protrusion of the stumps in question so that the leafless and cork-clad portions of all Carob branches come duly to be dotted with prominent wens. It is deep within these wens that most of the later inflorescences of the Carob Tree are engendered. The cauliflorous state of this plant is indeed due mainly to a seasonal repetition of this endogeny and to a rhythmic protrusion of wen-borne inflorescences in crowded groups along the courses of ageing branches.

Because of contrasts in plant-behaviourism which are considered later, it should be mentioned here that it seems to be a matter of indifference in the Carob Tree whether the product of any single axillary bud is an inflorescence or a leafy shoot. It is known, however, that all such buds on this plant remain somatic throughout the spring and early summer of the year in which their parent shoots are extended, and that it is in the autumn of that year that many of these buds are committed to the flowering state. So far, one has no reliable body of evidence to offer as to whether day-length, light-intensity, or temperature-relationship determines the autumn conditions of individual buds and settles their behaviour in the coming spring.

It so happened that members of the Lecythidean Myrtaceae had been among the first cauliflorous plants which the writer had attempted to study. They had shown a strict adherence to *exogenous* methods throughout their primary flowering. In their later display of cauliflory, they had paralleled broadly the endogenous methods of the Carob Tree. This resemblance had caused one to wonder whether the state of cauliflory is reached only by plants with a sustained power of internal organogenesis.

As will appear below, the answer to this query is in the negative. For even within a single alliance, such as the Leguminosae, the cauliflorous state is reached in diverse ways. The features of the Judas Tree (*Cercis Siliquastrum* L.) which are mentioned specially in these pages have a bearing on this diversity. Even their study and comparison may throw some light on systematic characters which have sometimes been considered

identical. For as in this plant, so also in others of different kinship, the cauliflorous state may have no relationship to endogeny but may be due to the presence of accessory buds formed *exogenously* by axillary meristems which are the counterparts of those already demonstrated for *Ceratonia*. One has selected the Judas Tree for more than passing note because it is among the dominant habits of this plant to use all its primary axillary buds in foliar shoot-formation and to reserve its accessory buds for delayed primary flowering upon mature and leafless portions of its twigs and younger branches. This behaviourism may readily be matched from among the Solanaceae, Berberidaceae, Saxifragaceae and Rosaceae. As to the case immediately in hand, there is a sporadic interchange of foliar and flowering shoots which merits later mention.

It emerges from the prior and the present statements that whereas the primary inflorescences of *Ceratonia* do not contribute directly to the cauliflory of this plant, those of *Cercis* are the first factors which make it cauliflorous. One may note also that the stumps of the primary inflorescences of the Judas Tree carry exogenous buds whose development is delayed. These buds give rise to further inflorescences in like condition. The yearly repetition of this double process of partial flowering and of basal bud delay leads to a massing of fertile stumps around the old sites of initial flowering so that prolific blossoming is maintained by exogenous methods alone upon sturdy leafless branches and the more massive trunk. Mention should also be made of a noteworthy distinction in habit between the Carob and the Judas Tree; and which has already been remarked upon in systematic writings. As to the former of these plants, the simultaneous display of its leaves and primary inflorescences constantly precludes any suggestion of precocious flowering within the growing crown. On the other hand, the protrusion of endogenous inflorescences from the leafless branches of this tree is often in advance of leaf-expansion. As to a Judas Tree, the impression of precociousness may well be given by it as a whole since all its accessory buds may remain puny and closed for a year and do not expand as inflorescences until at least the succeeding spring. This conspicuous flowering upon the lower and leafless portions of uppermost branches is generally well in advance of leaf-expansion upon more slender current shoots. The impression of precocious flowering for the tree as a whole is often strengthened by abundant early blooming from the stumps of old inflorescences along the entire branch-system below.

One may therefore conclude that neither the Carob nor the Judas Tree can offer a strict parallel to any other plant whose primary or accessory buds come to open flowering before their subtending leaves are expanded.

A later opportunity will be sought to consider the meaning of precociousness in its strictest sense and also to face some of its implications which bear upon morphological doctrines. Meantime, it must serve to state that enquiry into these matters has led to a clear recognition of the fact that the spring flowering of some plants which will later be in leaf may involve an early commitment of primary and accessory axillary buds in a way which is partly the reverse of that characteristic of the Judas Tree. In slight extension of this statement, one may add that flowering in advance of foliation is commonly due to a group of conditions which may

well be illustrated by any of the species of Goldenbell, such as *Forsythia suspensa* Vahl, which is a member of the Oleaceæ. The known conditions are as follows. Expansion of all primary and accessory buds is delayed throughout the first season of growth of their slender and leafy parent shoots. Before this season is closed, the nature of each member of any of these bud-groups is generally determined, the primary buds alone being committed as future inflorescences. The close of this first season finds the young shoots in the leafless state and so advanced in secondary growth that they are mainly cork-clad. Each group of buds still constitutes a close lineal succession which now stands immediately above a leaf-scar. It is not until the ensuing spring that most of these bud-groups have their activities renewed. The primary buds are in advance of their related accessory buds and are quickly expanded as inflorescences. Most commonly, the subjacent accessory buds are so retarded that they do not expand as foliar shoots until their related inflorescences have faded.

It appears therefore that the precociousness of a *Forsythia* is on a different footing from that of *Ceratonia* or *Cercis* and that a *Forsythia* will be strictly cauliflorous if the expansion of its flowering buds is delayed for more than a single year. In point of fact, a local retardation such as this is quite common in *Forsythia suspensa* and *Forsythia viridissima* so that portions of their branches may be in the second or third year of growth and may be sturdy and woody before their inflorescences are expanded.

A point of interest to systematists and physiologists may at least be approached if some deviations in the behaviour of the Judas Tree are mentioned. As has been noted above, the primary axillary buds of this plant dominantly become foliar shoots; its accessory buds are reserved mainly for primary flowering; and its secondary inflorescences arise generally from primary stumps. On the other hand, the development of the primary bud at any node is often delayed. It may remain in the purely somatic state and in a condition of seeming rest for more than a single year. The accessory bud immediately subjacent to it has furnished, meantime, a leafy shoot. This lateral shoot is often of very limited length when its first season of growth is closed. Unlike the longer and sturdier shoot formed dominantly by a primary bud, this limited shoot may flower early along its middle length. The formation of such a shoot commonly prefigures a prolonged dormancy of all other accessory buds at the node concerned and involves uncertainty as to their future state. These limited lateral shoots may wither immediately their primary flowering is completed. Their bud-bearing stumps become, however, cork-clad and persist as future sources of secondary flowering. Alternatively, these lateral shoots remain undamaged and may rest for a time after their early flowering phase has ended. They are not then prone to a concentration of basal flowering such as has been mentioned above. Most commonly, they grow with vigour in later years and come then to resemble in all their habits the branches formed elsewhere from primary buds. A long observation and comparison of Judas Trees has led one to expect that whenever the primary bud at any node gives early rise to a leafy shoot, the future state of all its subjacent buds is flowering. A second expectation has been that whenever an accessory bud gives early rise to a leafy

shoot, there are the following consequences. The primary bud is retarded. Failing its arrest, it is duly committed to flowering. The lowest accessory buds are greatly retarded. Their final products are more commonly a variable intermingling of inflorescences and leafy shoots than branches of a single category. The comparison has left one in little doubt but that the factors which determine these broad contrasts in behaviour for the lineal bud-successions of the Judas Tree are active and decisive within the slender current shoots themselves; and this to such a degree that the general course of future development is set for any bud-succession while the latter is still crowded upon a microscopic and axillary meristem.

One may note further that the habit of a Judas Tree is often affected by such local and active growth of its lateral shoots that sympodial branching of varied order is the common result. Whenever accessory buds determine this mode of branching, the primary buds above them remain at the forkings of the branch-system: the lowest accessory buds are so displaced that they soon lie abaxially at the broadened bases of the truly lateral shoots. The final isolation of these buds suggests, at first sight, that one is in the presence of adventitious buds: the true relationships of these buds to the other products of the successions are, however, never effaced since leaf-scars can always be traced beneath them.

Such varied development of the crowded products of tiny axillary meristems has a bearing upon the affairs of systematists. They have been selected for mention because it seems true that the absence of short lateral shoots, the constant selection of primary buds for the formation of lateral foliar branches, and the relegation of flowering to the basal buds of all axillary successions could be diagnostic features in themselves for a species of *Cercis* with constant monopodial branching. In like manner, the regular creation of a sympodial system through a pronounced development of foliar shoots from accessory buds could be a characteristic of some other species with primary flowering scattered by the lateral branches, as in the manner mentioned above. Parallels are known to systematists from among the *Bauhinias*, as, for example, *Bauhinia anguina* Roxb. and *Bauhinia scandens* Sessé et Moc., in both of which an interplay of foliar and flowering shoots is sometimes prominent.

One may note further that such monopodial and sympodial species of *Cercis* as have been suggested above would be strictly cauliflorous provided all the open acts of flowering were delayed upon any portions of their branch-systems until the latter were in secondary growth and had shed their leaves. A strict parallel to this may readily be furnished by the dominant condition of *Theobroma Cacao* L., which shows cauliflory in a marked degree.

The systematic point specially in mind relates to an uncertainty of estimation of the range of characters on which specific and generic rank are sometimes determined for tropical and subtropical plants. For while some such plants show a wide range of behaviour and habit, others are limited in these matters. One may illustrate such a range by using the limited variations already mentioned as a background and by then conceiving that the primary buds towards the upper limits of the current shoots of a Judas Tree give rise early to lateral leafy shoots whose growth is so dominant that the accessory buds beneath each one of them are

arrested completely. One may propose also an early dominance and a direct flowering of the accessory buds over the middle and basal regions of these current shoots and complete arrest of the primary somatic buds which might otherwise have furnished middle and basal foliar branches. Further, it is not difficult to conceive that the initial racemose development of the flowering accessory buds is so maintained that all lateral buds per inflorescence mature as flowers. The simple spikes thus formed would expand in leaf-axils: their withering would leave the plant without residual exogenous buds necessary to secondary flowering upon the leafless and thickened portions of the branch-system. Further, the active period of each axillary meristem could be so short that accessory bud-formation would cease at an early stage in the development of the current shoots. Thus whereas there might be from five to seven accessory buds in simple lineal succession in each leaf-axil, as is common in the Judas Tree, there might be only one accessory bud per node; locally, there might be none. And lastly, there could be no later phenomenon of cauliflory on the ageing branches unless the axillary meristems were re-activated or other tissue-masses within the nodes or internodes became local meristems.

The habit suggested above is unknown in any accepted species of *Cercis*. It is so far removed from that of the common Judas Tree that differences of detail in floral structure or in the arrangement of floral organs might determine some to adopt a view of generic distinctions based on the positions and conditions of mature organs alone. Nevertheless, there could be close initial similarity of organization for the shoots of the plants thus to be kept far apart; the sequence and the nature of the physiological steps in the ontogeny of these shoots could conform to a single scheme and could be in a single succession: the ultimate habit-differences could relate primarily to the incidence of each step and to the omission of ultimate steps which are delayed, rather than to any change of sequence whereby some physiological process is passed over or replaced by another.

As to flowering, it is known that acropetal development is sustained throughout all the early stages of the inflorescences of the Judas Tree. So long as the peduncle-apices remain somatic, the lateral buds of these inflorescences present an unbroken ascending series of developmental stages so that simple racemes are prefigured. The bringing of these apices to the state of tunic and corpus while the peduncles are still in the mid-phases of growth is followed by advanced preparations for terminal flowering, by basipetal commitment and development of the lateral buds as flowers, as on a cymose plan, and consequently to the retention of some basal buds in the somatic state; and upon which later secondary flowering depends. It is now known also that acropetal development continues undisturbed into the ultimate phases of growth of the inflorescences of *Cercis racemosa* Oliver; that the peduncle-apices of this plant dominantly mature in the somatic state; and that if these apices are brought finally to the condition of corpus and tunic and thence to flowering, this marks the last steps in an acropetal succession of transformations whereby mature racemes are assured.

It is among the present purposes to indicate the need of exact developmental knowledge regarding ontogenetic steps which lead to characters as now employed for both specific and generic distinctions. For there is no

well-substantiated understanding on these matters with either a physiological or a genetical foundation. In so far as one can judge of systematic practice, a plant with general resemblance to *Cercis racemosa* might be given distinct specific rank if its peduncular apices and the subterminal buds of its inflorescences remained somatic and gave regular rise to foliar shoots. Likewise a plant with general resemblance to *Cercis Siliquastrum* could be speciated apart if the basal buds of its cymes furnished no secondary flowering, but duly developed as foliar shoots alone. The four plants now in mind could show a close initial similarity in the organization of their forming inflorescences: the nature and sequence of their ontogenetic steps towards flowering could compose a single scheme with a fixed succession of steps: once more the final habit-differences between the inflorescences could relate primarily to the incidence of each step and to the fulfilment or omission of an ultimate step rather than to a change of sequence or a replacement of any one step by one of another nature. Thus, for example, physiological enquiry may yet show that the assembling and localization of an enzyme-system proceeds throughout the early developmental stages of future cymes and racemes alike; that its rate of assembling and localization is quick or slow so that the beginning of its reaction-time is reached early or late in ontogeny, and the apices within which it first operates as a developmental determinant are low or high on the peduncles. If the span of its reaction-time is long by reason of its continued concentration, all available apices may be brought to flower at some early date on either a racemose or a cymose plan. If its concentration diminishes as ontogeny proceeds, buds high or low on the peduncles may be residual in the sense already employed and may thus illustrate the omission of a potential step. A suggestion such as this is purely speculative. But whosoever follows it as a mode of approach to a character may think that decisions are overdue as to how both specific and generic characters can properly be assessed upon morphological features of foliar branch-systems, inflorescences, and flowers alike. Whether or not a gene is conceived as a determinative biochemical system, it is common practice to allow considerable latitude of body-form to a species, provided that, as with the Judas Tree, the general march of ontogenetic events is on such lines as have been indicated above. Whatever may be the causes of a display of such liberty of form, the latter has commonly been viewed as something 'natural' to a particular species whose status has been determined on other grounds. The absence of this latitude from another species has also merely been noted, and has not been used in speciation. It may well be that the explanation of constancy and variability of body-habit alike is to be disclosed along parallel lines to those now suggested for cyme-formation and raceme-formation respectively in *Cercis*.

All interested in systematic practice are conscious of a change of attitude when inflorescences are considered; distinct speciation being often decided upon the dominance of one form of inflorescence or of another, although both forms are potential in either plant according to the view given above. A decision is indeed taken and acted upon to transform extremes of latitude in behaviour into genetical specific differences rather than to unite the extremes under a single specific behaviourism. At the same time, this latitude must be admitted for

many individual species which, like the common Carob Tree, bear inflorescences of very varied form on single plants. The developmental record of the inflorescences of this plant has strengthened the view that any form of inflorescence within a definable range is determinable according to the incidence and duration of an ontogenetic step taken within an unaltered sequence.

It is in matters of floral morphology that the greatest change of attitude is observable: for here minor developmental differences are used specifically, and extremes of latitude furnish generic characters. This is brought home forcibly to a student of floral ontogeny immediately he has freed his mind from classical doctrines and can view each flower as an indivisible shoot within which a sequence of physiological steps will be displayed. The testimony of modern flowering plants seems to be that the first of these steps relates mainly to the bodily growth of a thalamus and that according to the incidence of this growth, the thalamus will remain dome-shaped with an obvious summit or will assume the form of a basin. In many instances dome-shape persists for a time and basin-form is later imposed distally. Whatever may be the form assumed, it seems to reflect a balance of cell-division and of cell-enlargement in various localities of the thalamus. The climax of this first step seems to be the definition of tunic and corpus when the thalamus is domed and of a meristematic lining to the basin as the equivalent to tunic when dome-shape is effaced. One need not enter here into other aspects of this growth-step further than to note that there is a rhythmic emergence of lateral apices from a domed thalamus and that equivalent apices are sooner or later protruded either upon or close to the rim of a basin-shaped thalamus. Nor need it be explained that, as in the present reference to steps in flowering and to the incidence and concentration of factors, so also in regard to body-features already touched upon, one does not imagine that the entry upon and the taking of any single ontogenetic step involves merely the concentration of some one biochemical substance or that the steps are discontinuous. It would seem rather that the prelude to each step is a complex balance which is alterable as development proceeds, and that the direction and consequences of any one step depend upon complex factors whose influence is subject to change.

As one sees modern flowering, the second ontogenetic step is towards the formation of androspores, which have been misnamed microspores. Its incidence may not affect the lowest lateral apices upon a domed thalamus nor the first-formed apices upon or near to the rim of a basin-shaped thalamus; the result, in both instances, being perianth in some form. This implies that if the factor for androspore-formation is effectual upon all apices which a thalamus of any form comes to possess, the ultimate flower will have 'male' organs alone. As has been outlined in the communication on *Ceratonia*, one has come to think that the androecial step now considered is a first and partial one towards the retention and increase upon any thalamus of meristematic or youthful tissue, as such; that if upper lateral apices and also the terminal apex of a domed thalamus are not committed to androecium, it may be in them that the third ontogenetic step is expressed so that, as is commonly the case, they enlarge considerably as carpellary organs whose characteristic feature is an

extensive development and retention of meristem. The equivalent third step within a basin-shaped and acarpous thalamus brings increase of the tissues of the basin as a whole, a marked increase of the inner surface of the basin, and the display of increased and retained meristem over the surface provided. One need do no more than state that, according to this, both a domed and a basin-shaped thalamus or one of transitional or other form may become entirely gynaeceal, not by reason of suppression of 'essential' or 'unessential' organs, but because increase and retention of meristem are early and fully effected. Likewise, as is common today, the development of floral organs may be strictly acropetal or otherwise, as on a racemose or a cymose plan, according to the incidence and reaction-time of successive factors.

It has been explained elsewhere how ovulation is linked inseparably with and is consecutive to the completion of the third step, and that its potential sequel is gynospore-formation, which has been misnamed megaspore-formation. One need not, however, extend the prevailing sequence of steps into embryogeny in order to reach the systematic bearing of this short recital of the behaviour of a thalamus.

Merely in illustration, is it not true in practice that the difference between hypogyny and epigyny has been considered so important that either has been given at least the value of a generic character? Is this not because the bearing on morphology of the incidence and duration of developmental steps taken in a single succession has been hidden by the retention of a classical dictate that epigyny emerges only by a long and complicated process of regrouping and alteration of 'essential' organs which may always be identified in hypogynous flowering? Are not the many floral forms already known for the Carob Tree witnesses to a wide potential range for any species? Whatever may be the results on the naming and ready identification of flowering plants, it seems that the behaviourism of a floral thalamus throughout development stands in as great need of study and understanding on physiological lines as do other shoots and shoot-groupings of a plant-body. The coming of this understanding may well restrain the foundation of new genera, discourage the multiplication of species, and lead rightly to a wider adoption of varieties than present convenience permits.

Returning for a moment to the general field of characters so far touched upon, one may underline simply the present uncertainty on systematic values. Until 1916, *Theobroma bicolor* Humb. and Bonpl. was accepted. As is recorded in 'Contributions from the United States National Herbarium', vol. 17, it has since then been made the foundation species of a new genus, *Tribroma*. Unlike *Theobroma Cacao* L., it does not show cauliflory. It bears only single axillary inflorescences over the mid-lengths of its current twigs. The inflorescences are short cymes which are raised gradually to internodal positions by meristems which form no accessory buds. The vigour of these meristems does not seem to be sustained on the older branches; and secondary flowering through basal buds on the cymes has seldom been observed. Herein are prime features suggested for generic distinction. Do they not run parallel to some discussed in these pages as meriting, at most, the recognition of a species of *Cercis*?

Many who might wish to examine some of the features mentioned so far may not have access to such plants as the Carob, the Judas Tree, or the larger species of *Bauhinia*. They may, however, have acquaintance with the accepted species and hybrid forms of *Forsythia* in which they will find parallels to the points which have been discussed, and also further features of common interest to systematists, anatomists, physiologists and geneticists alike. Here one can only touch on a few aspects of the behaviourism of these plants so that a field of study may be roughly defined. To date, the writer has studied these oleaceous plants to a limited degree, and has come to know that the observations of those who have cultivated them are more trustworthy as a basis for identification than are extant descriptions and illustrations. Without this special guidance, one may readily confound *Forsythia suspensa* Vahl and *Forsythia viridissima* Lindl. with some of their hybrid forms. The features discussed below relate mainly to *Forsythia suspensa*.

Springtime usually finds this shrub with long 'leader' shoots extended obliquely upwards; each being crowned by a compact winter bud. The upper reaches of the leaders were extended in the past season and are generally ready to flower openly before their terminal and lateral foliar buds will be expanded. This early flowering is referable mainly to the primary buds of simple and lineal axillary successions which were formed in the previous season by meristems like those of *Cercis*, and which stand, in early spring, immediately above leaf-scars. A seasonal comparison of terminal buds, of the young extensions added by these buds to the leaders, and of these current additions as they have reached their primary maturity in autumn shows that all flowering buds which expand in springtime were 'determined' and differentiated during the preceding summer and autumn. The only obvious direct bearing of the physical conditions of spring upon them concerns their expansion-time.

Mention should be made here of a few connected points which affect at least *Forsythia Giraldiana* Lingelsheim, *Forsythia europaea* Dogen and Baldacci, *Forsythia viridissima* and *Forsythia suspensa*. The first is that there may be no flowering along the upper reaches of the leaders in a particular spring. Commonly, this is related to the facts that the primary bud of each high axillary series has remained somatic, that the accessory buds beneath it are retarded, that the flowering characters of the primary buds commonly remain undecided until the ensuing autumn, and that they do not expand until the following spring. Consequently, there is considerable flowering in some springtimes along the lower, older and thickened portions of leader-shoots.

There is a matter of physiological interest here since, in the first place, there are seldom more than three or four accessory buds in each lineal succession. Secondly, by far the most common sequel to the early flowering of the primary buds in the species mentioned above is the protrusion of relatively short lateral foliar shoots from the uppermost accessory buds, as the inflorescences fade. Many of these short shoots may never attain great length or sturdiness. If they wither early, their most common records are short sealed stumps not unlike those of the faded inflorescences immediately above them. The lowest accessory buds per succession are generally greatly retarded: dominantly they prove to be arrested when-

ever, at some later date, the short foliar shoots assume such vigour that they come to furnish main lateral branches to the parent leaders. Thus there are many nodal positions along the old and sturdy portions of the leader-branches of these species at which lateral shoots are absent. At the moment, one has no suggestion to offer as to the cause of this seeming 'opposition' of inflorescences to foliar shoots in *Forsythia*; but it appears that there is something worth probing here in view of a further feature. This is, that it is from the nodes at which primary flowering buds are arrested that the main lateral foliar branches spring. In some species they remain solitary to right and left of a node and quickly attain considerable length. They slope obliquely upwards in *Forsythia viridissima* and help to define a shuttlecock-like crown. Many of them gradually become pendulous in *Forsythia suspensa* and then determine its named specific feature. But there is more to be noted and explained than the length, the robustness or slenderness, the rigidity or curvature, and the various inclinations of these shoots in the known species and hybrids. This will be evident at a later point. It would, however, be wrong to conclude that the rapid development of these lateral shoots relates merely to the delay or the arrest of primary lateral buds which might have flowered early. For one has found that, here or there along the lengths of leaders of both *Forsythia suspensa* and *Forsythia viridissima*, a main lateral shoot is the product of a primary bud and that the accessory buds beneath it are prone to great delay or to arrest. On the other hand, there are hybrid forms of these two species in which there are at least twin lateral foliar shoots to both the right and the left at some nodes; the primary one being dominant and liable to basal branching, while that formed from the accessory bud immediately beneath it is less sturdy, but nevertheless enduring. This condition often occurs in the plant named *Forsythia intermedia* by some authorities.

Even these brief references to axillary bud-successions in *Forsythia*, to the dominance of flowering by the primary buds, and to the more common formation of foliar shoots by accessory buds may encourage some to study such buds and their parent meristems, both biochemically and histologically, at successive seasons in the hope of securing information regarding factors affecting somatic and reproductive development respectively.

The more upright vigorous lateral shoots extended in the second year from short shoots of *Forsythia suspensa* are also of interest since they commonly show changes of phyllotaxis which precede the definition of their winter apical buds. There is a well-known parallel in the Privet.

There are a number of directions in which the forming current shoots and the terminal winter buds of the *Forsythias* are worthy of special study. Thus, for example, springtime may find the terminal bud of a leader shoot with a short domed axis, a deep cap-like apical meristem surmounting a parenchymatous massive, a close acropetal succession of decussate leaves, and a complete absence of axillary buds or of protruding axillary bud-initials. The epidermis and hypodermis of the outermost leaves are suberized completely on both faces so that there is no residue of living tissue on the adaxial surfaces or in the axillary positions. These dead abaxial and adaxial sheets merge into a suberized massive involving the entire leaf-tip. As one passes upwards through the successive pairs of

leaves, more and more leaf-base is free from suberization on both faces, and the mass of corky leaf-tip correspondingly diminishes. It is roughly at the levels of exposure of successive leaf-pairs above their predecessors that suberization begins. Only the uppermost pairs of completely enclosed leaves are entirely unsuberized when springtime comes. There is no exact information as to the causes of this almost complete or only partial assumption of the scale-habit by the outer leaves. All that is known with certainty is that as late autumn brings a restriction and then a cessation of lengthening internodes, one may use the progress of suberization as a guide to the course of maturation of leaf-tissue. In *Forsythia suspensa* and *Forsythia viridissima*, this maturation begins abaxially, involves the leaf-tip, and then extends towards the leaf-axil. A fairly extensive comparison of the expanding and expanded terminal buds of these two species tempts one to think that the later presence of axillary buds relates as much to the retention of youthful tissue at the adaxial bases of leaves as to axillary or internodal meristem in any sense apart. The comparison has failed to reveal even a single bud axillary to a scale-leaf, the adaxial surface of which is fully suberized. As to lengthening internodes, it has indicated that the suberization of their skin and hypodermis begins at the leaf-bases, and that the existence of axillary bud bearing meristems and of single axillary buds alike depends on the retention of a residue of living epidermis and hypodermis which belongs as much to the adaxial face of the leaf as to the internodal base. One may think therefore that the 'choice' of axillary positions for bud-formation is not obligate but is merely the most natural one so long as tissue-maturation in leaf and internode respectively leaves only a limited living mass for bud-formation. And since developmental study of current shoots of *Forsythia suspensa* has shown that the primary bud of each axillary succession is initially inseparable from its related leaf, and that, as it is raised to an internodal position, the increments of axillary meristem which it comes to surmount are formed with a like leaf-relationship, enquiry is indicated as to whether the existence of axillary meristems, their bud-output, and the duration of their activities may partly be explained in terms of the rate, extent, and interruption of maturation processes affecting primarily superficial and hypodermal tissues. If it is reasonable to suggest that the present dominance of single axillary buds in angiosperms reflects a minimal retention of superficial formative tissue between leaf and axis, may there not be alternative conditions in which a high growth-potential could continue to express itself either through the protracted development of individual leaves and internodes on an ever-green plant or through so extensive adventitious budding that the condition common in many ferns would be matched or surpassed?

There are two directions in which the present notion as to the presence or absence of axillary buds or bud-bearing meristems can be checked in the *Forsythias*. Thus the terminal bud of a leader shoot of either of the species discussed may be committed to flowering in the autumn, just as may any primary lateral bud. In both cases the final product is a uniflowered or multiflowered cyme; the flowers being crowded distally and matured basipetally in the case of a multiflowered cyme. The known evidence is that the bud has a close decussate succession of leaves by mid-

autumn ; that the basal leaf-pairs are soon almost fully differentiated scale-leaves without any signs of axillary buds ; and that any apices which are defined apart from the terminal one are axillary to the distal leaves which retain unsuberized epidermis and hypodermis at their axillary bases. The terminal and upper lateral apices thus defined are soon the only protruding points of growth within these flowering buds as a whole : they are the only known points of flower-formation : throughout the late winter and early spring, no trace of apices or of buds has been found in the axils of leaves with fully suberized adaxial surface. Axillary buds have been noted as low as the third decussate leaf-pair, in December and January ; these leaves being only partly suberized. Expanding flowers are also found in these positions, from time to time, in late spring ; their associated leaves have proved to be incompletely suberized.

The second direction in mind concerns the midsummer condition of foliar buds along the mid-lengths of the most sturdy leaders of both *Forsythia suspensa* and *Forsythia viridissima*. As already noted, both primary and accessory buds in this position are often ready to furnish new lateral leaders. Viewed as a whole, any nodal group of these buds seems no longer to be in a simple lineal succession but so suggests a bud-cluster that it has sometimes been interpreted as a lineal arrangement with independent buds to right or left or otherwise. In reality, the simple lineal succession is the basis of the group : the now prominent lateral buds are low branch-buds upon the primary ones : the upper accessory buds may also bear low and prominent lateral buds and may thus complicate the grouping : no exception has been found to the rule that the adaxial base of the subtending leaf is quite unsuberized ; and this despite the fact that the abaxial surface and the tip of each leaf subtending a lateral bud is soon fully suberized. Furthermore, it has often been noted that although the course of leaf-suberization is acropetal in these forming foliar shoots, and that although their bud-initiation is likewise acropetal, there may be no lateral buds at the bases of primary or accessory buds by late summer if adaxial suberization has progressed early in the season.

The purpose of the foregoing remarks is to stimulate interest in the specific course of development of the superficial tissues of the branch-systems of angiosperms. For it seems that through the study of this aspect of behaviourism, some understanding of mature morphology may come and may have its effects on systematic values. One is already satisfied that study of this nature is not a wasted effort. For it is apparent, even now, that such features as the retention or shedding of hairs, the early or late initiation of bark, the prominence or obscureness of lenticels, and the colours of immature and mature internodes—which aid systematists in speciation,—can be rationalized and can furnish suggestions for both physiological and genetical enquiry.

Only a few further related matters can now be mentioned. They concern the behaviour of the pendulous leaders of *Forsythia suspensa* and of their more or less upright or horizontal equivalents in *Forsythia viridissima* and of the central hybrid-form known to many as true *Forsythia intermedia*. Horticulturists have already an interest in these shoots, as is illustrated

by Kirk's remark that the 'weak arching stems' of *Forsythia viridissima* root easily, and by that of Tidestrom that *Forsythia suspensa* has 'more or less vigorous forms,' some of 'the more rambling kinds of which root from the joints almost as readily as a bramble.' It is true that layered or several branches of these plants form true roots and are able to do so at many points; but this provided they have almost completed their vigorous growth in length or are attached to 'old wood' from which they may continue to elongate. As appears below, more than root-formation may be involved. Reference should be made first to the dominant behaviour of the pendulous shoots of *Forsythia suspensa*.

The advance of summer generally witnesses their grand period of growth as slender branches, with exclusively foliar buds. The young distal reaches of those which hang from high positions on the branch-system may be almost vertical long before they approach soil-level. Their elongation may continue thus until their tips are at a distance of under two inches from the surface of the soil. There may then begin an abrupt curvature of the shoot at the last node from which leaves are almost fully expanded. The future advance of the shoot-tip may continue at or above soil-level until growth in length has ceased, without the clear definition of a terminal winter-bud in progress. Quite commonly, the shoot-tip has penetrated the soil to some depth before the curvature is shown. This means that curvature occurs duly at a subterranean node and that the later elongation of the shoot proceeds underground. Most commonly, the shoots inserted at low levels upon the plant-body approach the soil with only a gentle downward slope and extend later above soil-level without a display of special curvature at any node.

As a first step towards the study of this uncertain shoot-curvature, one has raised the soil to various levels around individual plants in early summer so that the pendent shoots approach the soil while they are still short and young. It has been noted, to-date, that the tips of the youngest pendent shoots are not prone to curvature but may pass directly underground. This observation must be checked by many others. It has suggested, however, that whatever may be the light-intensity at soil-level, there are physiological conditions which must be fulfilled close to the shoot-tips before curvature can occur, and also that these conditions are developed only gradually so that may not be realized fully until the shoots are middle-aged and have normally attained considerable length.

The second phase of development of these pendulous shoots is of peculiar interest. Its beginning may be defined roughly by a marked response of young and maturing petioles to light and by tissue-increase at the nodes, particularly towards the under-surfaces of long prostrate shoots whose tips may soon curve upwards. The main nodal swellings cause a displacement of the leaves and of the axillary bud-groups. Once they are evident, they are generally raised locally by low bosses with papery tips which often become brown. These bosses may or may not relate to stomata. They vary in number and distribution, and may be formed along the lengths of young internodes, despite the variable inclination of the parent shoots. These bosses may not be the points of origin of true roots but are the initials of rhizophores which, hitherto, have not been recognized as such in extant descriptions. The skin, the hypodermis, and the deeper cortical

tissues of both the nodes and the internodes are involved alike and remain unruptured throughout the formation of these initials, no one of which has a deep-seated and liberated apex of its own, as in the case of an endogenous root. The papery appearance of the tips of the young rhizophores is due to a forming corky mantle which is continuous with that of the node or internode. The progressive browning of the tips is due partly to the death of skin and, in part, to the maturation of cork beneath it.

A lengthy statement is necessary to even a general account of the histology, changing states, and root-production of these strange organs ; and it cannot be given now. One must be content to draw special attention to their main development at the penultimate nodes and internodes of shoots whose elongation is far advanced, but which is still to proceed before summer is past. Here again it seems as if there is a phase in the careers of these shoots at which alone the induction of rhizophores and consequent rooting may be expected. One has noted often that both subterranean and sub-aerial rhizophores may branch in many ways ; and this while they are still mere bosses on the parent shoots or when they renew their growth in length after a period of dormancy within a continuous cork investment. The roots which they bear are truly endogenous : their initiation *may* bring the first signs of vessels within the rhizophores themselves. So long as the latter are fully cork-clad, their massive ' apical ' meristems are limited externally by a cork-cambium. These meristems may become, in time, as apical as those of foliar shoots so that their skin-clad tips protrude beyond a corky tube. The rhizophores may then enter distally into the state of foliar shoots which emerge above ground. This indeterminateness is such that even a rhizophore which is fully covered by cork may elongate in any direction. When many rhizophores are formed at a bulky node, some may form short warty swellings and may have a long period of dormancy : others may have their directions of growth so different that their functional apices emerge finally within the pith-cavities of the internodes, and may then lengthen and branch internally. But whatever be their arrangement or growth-rate and form, they cannot establish a pendent shoot as an organ of propagation until they are root-bearing.

It is still uncertain whether true roots are ever formed directly from the pendent shoots of *Forsythia suspensa* or from the ' weak arched branches ' of *Forsythia viridissima*. But it is known that these branches have also the power of rhizophore-formation from both nodes and internodes, and that the elongation of these shoots is considerable before this faculty is expressed. To date, one has not seen any late acts of flowering upon shoots of *Forsythia suspensa* which have been layered naturally on the surface of the soil. The equivalent shoots of *Forsythia viridissima* have been found occasionally to flower at soil-level during their second year of growth ; and this even at middle nodes which have borne rhizophores. The more upright branches of both these species have been used to a limited degree as cuttings to be set in early and late summer. So far, they have shown no rhizophore-formation, and true root-formation has been slow and uncertain. One is therefore tempted to think that, despite their early vigour and considerable length, they do not attain distally the physiological conditions of the pendent branches. The behaviour of the

latter leads one to realise how important may be a knowledge of specific behaviour to physiological study. For if there is a stage or season in the development of a plant-organ at which a phenomenon may at least be expected, is it not just prior to and during this known stage that physiological enquiry may be pursued most hopefully?

Only one point of interest to both physiologists and geneticists need be mentioned from among the many presented by *Forsythia intermedia*. There is a common form of this true hybrid with sturdy leaders which furnish a shuttlecock-like crown, much as in *Forsythia viridissima*. The equivalents to many of the short lateral shoots of *Forsythia suspensa* are flexuous shoots of rapid growth and considerable length. While flowering proceeds on the main upper branches, it is upon the flexuous shoots that rhizophores are initiated in great profusion and in crowded groups at both nodes and internodes. They may increase in number as the growth in length of their parent shoots is reduced. These rhizophores are generally short, and quickly reach the dormant state so that, as their parent shoots become 'woody', each swollen node or internode becomes a 'gall', from which the corky tips of the rhizophores protrude. These short rhizophores are not easily re-activated by the layering of their parent shoots. So far, they have not been known to form true roots. The equivalents to their parent shoots in *Forsythia viridissima* are lateral branches of moderate length which flower along their middle reaches, and whose apices extend as leafy shoots when flowering ceases. It need hardly be stressed that the rhizophore-formation now in question is not dependent on diminishing light-intensity.

The purposes of this article will be fulfilled if an interest in the changing behaviour of flowering plants is quickened once more. As one sees many modern trees and shrubs, their long and interesting careers give a wide opportunity for the study of evolving characters, each of which has its own time of declaration and amplitude, its definite morphological results, and its own bearing on systematic criteria.

Is it not then right to recall that our final interests in living creatures relate to their kinships, and that systematists require a rational explanation of each character which they employ? Is it unreasonable to hope that, in the near future, there will be close co-operation between morphologists, anatomists, physiologists and geneticists in the intimate study of some one plant which has already been named and described?

Discussion.—

Professor F. E. WEISS expressed his appreciation of Prof. McLean Thompson's careful and interesting investigations on the nature and conditions of cauliflory. In connection with *Cercis* we should have to revise our views of the immutability of cymose and racemose branching since both might occur in the same plant. Was it possible that this depended on the greater or less vigour of root nutrition? The same cause might determine the formation of cymes or racemes in the inflorescence. No doubt the formation of single or multiple groups of flowers depended on the vigour of the shoot, which would probably be affected by the nutrition of the plant.

In connection with *Forsythia* he was greatly intrigued by the occurrence of such peculiar organs as rhizophores. They reminded him of the similar organs in *Selaginella* which in some species were not only root bearers but might under certain circumstances develop into leafy shoots. It was curious that in a flowering plant we should have the occurrence of such a primitive organ.

Dr. C. R. METCALFE said that Professor McLean Thompson's interesting investigation raised fundamental physiological problems of great importance which are still a long way from being solved. In order to understand the full significance of the morphological behaviour of the cauliflorous plants which had been described, it would be necessary to ascertain what causes determine the location of meristematic tissue, and the nature of the products to which initially 'indifferent' meristem gives rise. From what little is known concerning these matters it seems that food supply, hormones and genic control must all exercise an influence at least on the mode of development of meristem, if not on its location. The relative importance of these three influences appears to vary in different instances.

Goebel (2) recorded, many years ago, how a reproductive cone of *Selaginella lepidophylla* will give rise to a terminal vegetative shoot bearing rhizophores if cut off and kept under moist conditions; how an inflorescence of *Veronica Beccabunga* also forms a terminal vegetative shoot bearing foliage leaves when treated like a cutting; how maize plants on poor soil in a weak light produce a male but no female inflorescence; how removing a ring of bark from a sterile apple shoot will stimulate the formation of flowers and fruits. All of these examples show that a modification of the food supply can induce a change in the nature of the products to which meristems give rise.

Change in the length of day also exercises a control over meristematic behaviour. For instance, Goebel has recorded how the biennial *Echium vulgare* lived for ten years without flowering when introduced into Southern Brazil. Conversely, it is well known to botanists at Kew that many plants introduced into the gardens from tropical countries also fail to flower. It is now commonly believed by plant physiologists that hormones play a part in the mechanism whereby plants respond to the length of day or photoperiod to which they are exposed. Cajlachjan (1) claims to have shown how a factor controlling photoperiodic response can be transmitted across a graft union, and has suggested that flower initiation is induced by a hypothetical hormone-like substance for which the name 'florigen' has been proposed. American work by Hamner and Bonner (4) also indicates that in *Xanthium pennsylvanicum*, a 'short day' plant, the photoperiod is 'perceived' by the leaves and that its effect can be transmitted even across a diffusion contact to another part of the same plant submitted to a long photoperiod. The same authors concluded that flowering, i. e., the differentiation of meristem in a definite direction, is controlled by a substance formed in the leaves when submitted to a short photoperiod, whilst the development of flowers and fruits may be controlled by a similar or identical substance. It is unfortunate, in view of these and other interesting results, that the chemical identity of plant hormones has so far been established in only a few instances, whilst the forms in which they occur, and their relationship

to other chemical substances such as proteins and enzymes with which they enter into chemical combination or by which they are controlled are only beginning to be understood (3) (7). More fundamental work with hormones will be necessary before the mechanism underlying the behaviour of the plants discussed by Professor McLean Thompson can be fully appreciated.

Mr. Marsden-Jones (5) has already described to the Linnean Society how *Ranunculus Ficaria* exists in two forms, one of which is diploid, free flowering and devoid of axillary tubercles above soil level, the other being tetraploid, producing relatively few and frequently sterile flowers whilst tubercles occur in the leaf axils. Subsequent work of my own (6) has shown that the aerial tubercles, which are morphologically roots, arise exogenously from buds; how secondary meristems laid down in the tubercles sometimes give rise to roots and sometimes to buds, their behaviour in this connection being quite unpredictable on morphological grounds. *R. Ficaria*, therefore, provides an interesting plant for comparison with those described by Professor McLean Thompson, since it includes meristems of which the behaviour is unpredictable, whilst the aerial tubercles provide ample evidence that the line of demarcation between root and shoot systems are not always so clear cut as was at one time believed. I also found that application of indolyl acetic acid, a hormone-like substance which induces root initiation in many plants, to the leaf axils of forms of *R. Ficaria* without aerial tubercles, failed to induce the initiation of roots. This result suggests that hormones may be unable to operate on material which is genetically unsuitable. In other words it seems, in instances of this kind, as if genes exercise an overriding influence in controlling the form and behaviour of plants. The examples cited above collectively indicate that meristem is controlled by a complex balance between nutritional factors, hormones and genes.

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Mr. I. H. BURKILL with the view in mind that the rhizophores are stem structures, said that the initials of new stems arising from originally completely budless pieces of tubers of the Black Bryony, *Tamus communis*, appear as wens, with the cork of the tuber, broken into small bits by the growth from within, attached to the surface; after that a foliated bud

is originated at the apex. Until the bud becomes evident, they greatly resemble the rhizophores of *Forsythia*.

Dr. R. MELVILLE said that in his experience the pendulous shoots of *Forsythia* only produced root initials under weak illumination and in a relatively humid atmosphere. Such conditions were found at the back of a bush growing against a wall or when a shoot pushed its way between the boards of a fence. If a shoot touched the ground it rooted quite readily in full light. *Forsythia* was very easy to propagate. Similar growths on the branches of the apple were used in commercial propagation, as were the burr-like growths on the trunk of the olive, which resembled the burrs of the carob but did not produce flowers.

The importance of nutrition as one of the factors affecting flowering had been mentioned. Nutritional factors appeared to play a part in the flowering of *Forsythia*. Weak and shaded branches produced either vegetative buds or single flowers; cymes with a variable number of flowers were found only on the vigorous and well-nourished branches. The elms provided another interesting example. The distal bud of a shoot is always vegetative, but a variable number of the lateral buds may be flowering buds. The number that pass into the reproductive phase seems to depend on weather conditions during the season preceding flowering. It is greatest when the weather has been good and the light intensity high, conditions under which carbohydrates and probably other nutrients accumulate. The lateral buds appear to pass into the reproductive phase in basipetal succession. Their fate, whether vegetative or reproductive, appears to be settled by about the end of July.

Mr. W. C. WORSDELL: In *Ceratonia* (Carob) the 'raising' or 'up-lifting' of the primary inflorescence on to the internode of the main axis of plants is due to congenital fusion (adnation) of its base with that portion of the main axis, accompanied by elongation of both. The exogenous and endogenous accessory inflorescences must both arise from the stumps of the primary inflorescence. The monopodial type is more primitive than the sympodial or cymose type of inflorescence. In *Cercis racemosa* the inflorescence is thus of a more primitive type than that in *C. Siliquastrum*.

In *Forsythia* it is not uncommon for ordinary adventitious roots to form on shoots growing in a moist environment. The 'rhizophore' is probably a highly-modified form of adventitious root, as the majority of its features suggest; the formation of stem-buds on it occasionally is not incongruous with this view, as there are plenty of cases of stems arising adventitiously on roots. This structure is not comparable with the 'rhizophore' of *Selaginella*, which I consider that I have shown to be a stem-structure.

Mr. J. S. L. GILMOUR exhibited a specimen of *Forsythia intermedia* in which 'rhizophores' were developed inside the hollow stem, completely filling the cavity. The plant was growing in a heavily shaded place.

In concluding the discussion the President remarked that for very many years he had known of the occurrence of these adventitious roots on *Forsythia viridissima**. They were often very abundant and formed gall-

* Subsequent examination of specimens shows that it was the hybrid named *F. intermedia* Zabel (*F. viridissima* × *suspensa*) on which adventitious roots were so commonly present. As far as the Kew shrubs are concerned they are not present on *F. viridissima* itself.

like swellings and occurred on upright and horizontal as well as on pendent branches. The galls were largest on the shady side of the tree. He had not observed them on the drooping branches of *F. suspensa*, not even on branches which touched the ground.

PROCEEDINGS OF THE GENERAL MEETING

22 March 1945

Mr. A. D. COTTON, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 8 March 1945, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Dr. Isabella Gordon and Mr. Brian Vesey-FitzGerald.

In accordance with Chap. 10, Sect. 8 of the Bye-Laws, the following Fellows were elected, by show of hands, as Auditors of the Treasurer's accounts for 1944–45,—

Representing the Council,—Mr. A. A. Pearson and Mr. R. Winckworth.

Representing the Fellows,—Mr. D. J. Scourfield, I.S.O., and Dr. J. Hutchinson.

The following communications were read and discussed,—

Mr. I. H. BURKILL. Abnormal gamopetalous flowers of the poppy, *Romneya Coulteri*, and the way in which its sepals protect the sexual organs. (Discussed by Mr. W. C. Worsdell, Dr. M. A. Brett, Mr. A. H. G. Alston and Dr. B. Barnes ; Mr. Burkill replied.) [Printed in full, below.]

Prof. D. M. S. WATSON, F.R.S. Evolution of the Elephants. (Discussed by Mr. C. H. Hooper, Dr. A. T. Hopwood, Dr. F. E. Zeuner, Mr. J. S. L. Gilmour and Dr. Malcolm Smith ; Prof. Watson replied.)

[This paper has been printed in 'Biological Reviews', xxi. n. 1, 1946.]

Abstract.—

Nearly a hundred years ago Hugh Falconer showed that late Tertiary rocks in India yielded fossil remains which provided a complete series of intermediates between the teeth of Mastodons and those of true elephants.

Forty years ago Dr. C. W. Andrews described two mammals from Egypt which were essentially ancestral to one another and to the Mastodons, and went on to show 'how the elephant got its trunk'.

Now the late Professor Osborn, bringing together the bulk of the existing information, shows that the Proboscidea include some six stocks, which independently pursue parallel evolutionary courses, ending at different times and stages, but in two cases leading to forms which have a head of true elephant shape.

A review of all the evidence leads to the suggestion that all the essential parts of the evolution of elephants (those, that is, which pursue parallel course of change) result from modifications of proportion necessary to make animals steadily growing larger as well designed as their smaller ancestors. That, in fact, the fundamental change which leads to almost all others is an increase in adult body weight. To what this increase is due is unknown, but it is clearly not related directly to any particular set of environmental conditions.

ABNORMAL GAMOPETALOUS FLOWERS OF THE POPPY, *ROMNEYA COULTERI*, AND THE WAY IN WHICH ITS SEPALS PROTECT THE SEXUAL ORGANS.

By I. H. BURKILL.

A VIGOROUS plant of the poppy, *Romneya Coulteri*, raised from seed and growing in a garden in Leatherhead where I have been able to observe it for a few years, produces flowers with 4 and with 6 petals, intermixing a few with 5; and last year it produced three gamopetalous flowers, with corollas as campanulate as that of a *Convolvulus*. Two of these flowers are exhibited. It is apparent that the petals had grown up from their origin as a ring*.

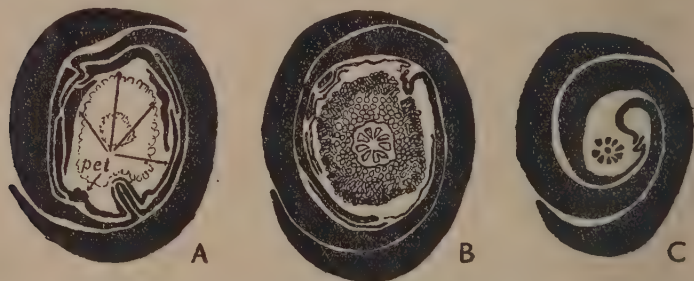


FIG.—A bud, 6–7 mm. through, of *Romneya Coulteri* in section :—A, just above the origin of the petals (*pet.*), five in number. Along with the two fully formed sepals, a third is within that on the left, much undersized, its more active margin towards the lower part of the figure. B, through the bud a little above the base of the ovary. The more active margin of the sepal on the left has a turned over part which is cut in two places and it has extended its expansion so as to work its way within one of the petals. C, through the upper part of the bud showing the stigmas, nine in this case. All $\times 5$.

Gamopetaly has been observed in *Papaver Rhoeas* Linn. (Hoffmann in Bot. Zeitung, xxxv, p. 290; 1878), but is a most unexpected abnormality in any of the *Papaveraceae*. Gamosepaly, on the other hand, is characteristic of certain genera wherein the rudiments of the sepals arise in the forming flower separately to become united by extensions of the contributions from

* The two abnormal flowers have been given to the Royal Botanic Gardens, Kew, for record in the Herbarium.

the stem (see Payer, 'Traité d'Organogénie comparée de la fleur', p. 218; 1857). As there was a growing bud on my *Romneya* in proximity to two of the gamopetalous flowers, in hope of it also being gamopetalous, I obtained serial sections of it; but I was disappointed. It proved to be 5-petalled.

Yet though I failed to get what I sought, I found the bud interesting on account of the way in which the sepals protect the organs within. *Romneya Coulteri* is native on the sides of streams in very dry valleys of California. Against the dryness of the air in such places the sepals are very leathery and thick, and they grow more on one margin than on the other in such a way that one margin of each sepal pushes itself within the other sepal to make a defence round the inner organs of the flower, sealing up more tightly the already sealed up bud. Three drawings to scale, given above, illustrate this. When Harvey described the genus (in Hook. Lond. Journ. Bot. iv, p. 74; 1845) he had 3-sepalled 6-petalled flowers wherein the augmented growth of the sepal margin did not extend to the base of the sepal. In my plant it does, and a crumpling such as is so familiar in poppy petals begins in *Romneya* with the thin sepal margin. It is seen in figure A and became more extensive at a slighter higher level; at the level of figure B there was not much, but towards the upper side of that drawing are seen two bits of inturned edge which pressed the petals in and towards the base is seen the sepal margin seeking room for its growth by slipping within one petal. The other sepal had pushed its margin among the anthers.

The outer surface of the sepals is waxy and has a few stomata which are slightly sunk in the epidermis. There is a very small air space under each stoma; otherwise the tissues are devoid of intercellular spaces. The push of growth greater at the outer face than at the inner, causes the sepals to grip each other; they are tightly in contact in life, but preservation for sectioning destroys this and of course the contact cannot be represented in these black and white drawings. Organs so leathery and rigid are unaccommodating in the expansion of the flower and the plant discards them, for which act already in the half grown bud an absciss layer is well defined.

PROCEEDINGS OF THE GENERAL MEETING 26 April 1945

Mr. A. D. COTTON, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 22 March 1945, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting:—Dr. L. H. Bailey, Dr. J. G. Hawkes, Dr. W. R. B. Oliver, Dr. E. Soysa, Mr. E. E. Syms, Mr. G. E. Trease, Capt. F. Kingdon Ward, Professor F. E. Weiss and the British Council.

The President announced that the following Congratulatory Address is being sent to the Board of Managers on the fiftieth anniversary of the founding of The New York Botanical Garden,—

THE LINNEAN SOCIETY OF LONDON.

conveys heartiest congratulations to the

BOARD OF MANAGERS OF THE NEW YORK BOTANICAL GARDEN

on the Fiftieth Anniversary of the founding of The New York Botanical Garden, and desires to associate with other institutions in the appreciation of the great results attained during that period.

It is recalled that the first botanic garden in America was begun in 1728 by John Bartram, a correspondent of Linnaeus, and that the founding of the New York Botanic Garden, now one of the greatest in the world, was largely due to the vision and energy of Dr. N. L. Britton, its first Director-in-chief and a Foreign Member of this Society.

By a happy combination of generous private effort, participated in by both rich and poor, with help from public funds, The New York Botanical Garden, with its great herbarium, its library, and its publications, has become a magnificent example to other peoples. That it may continue to flourish as in the past and that its illustrious record may be still further enhanced is the sincere desire of The Linnean Society of London, whose Common Seal is here affixed this twenty-sixth day of April in the year 1945.

L.S.

A. D. COTTON, *President.*

F. C. STERN, *Treasurer.*

MALCOLM A. SMITH, } *Secretaries.*

B. BARNES,

The President reported the deaths of William Holmes Burrell and Col. Masters John Godfery, Fellows; Professor Eugène L. Bouvier, Foreign Member; and Thomas Sheppard, Associate of the Society.

Certificates of the following candidates for Fellowship were read for the first time: in favour of F. J. Aumonier, M.Sc., M.R.C.S., L.R.C.P., Eric W. Baxter, B. Sc., Thomas E. T. Bond, Ph.D., Brian L. Burt, B.Sc., Dr. Ley Cernovitov, Alfred C. Cramp, Norman F. Ellison, William David Evans, M.Sc., Ph.D., David W. Goodall, Ph.D., W. B. Gourlay, M.C., M.A., M.B., B.Ch., R. W. Haines, M.B., D.Sc., J. G. Hawkes, M.A., Ph.D., Mrs. Vera Higgins, M.A., J. D. Macdonald, B.Sc. (For.), B.Sc., Miss Lucy B. Moore, M.Sc., Mrs. Minnie Moore, B.Sc., Mrs. Frances Perry, J. A. Pringle, M.Sc., J. Proskauer, B.Sc., J. W. Purseglove, B.Sc., Leonard T. Raeburn, John Grant Roger, B.Sc., Harold V. Rose, Miss Lorna I. Scott, M.Sc., J. B. Scrivenor, I.S.O., M.A., J. R. Sealy, B.Sc., Miss M. V. Thompson, B.Sc., and Thomas G. Tutin, M.A.

The following communications were read and discussed :—

Sir FRANK COLYER, K.B.E. Caries of the teeth in animals. (Discussed by Dr. Edward Hindle, Dr. G. Carmichael Low, Dr. W. Warwick James, Dr. Malcolm Smith and Dr. V. V. Tchernavin; Sir Frank Colyer replied.)

Dr. CLARA M. WARREN. Fungus infections of the skin. (Discussed by Mr. E. W. Mason, Dr. W. Warwick James, Miss E. M. Wakefield, Dr. G. Carmichael Low, Prof. C. T. Ingold, Miss May Rathbone, Dr. S. M. Harding, Dr. B. Barnes and the President; Dr. Warren replied.) [Printed in full, below.]

Dr. V. V. TCHERNAVIN. Description of five specimens of *Lyomeri* (deep sea fishes) preserved in the British Museum, with notes on their skeletons. (Discussed by Lt.-Col. W. P. C. Tenison, D.S.O., Dr. E. Trewavas and Dr. R. W. Haines.)

Abstract.—

The *Lyomeri* are curiously shaped, rather large, bathipelagic fishes. The largest specimen recorded is 6 feet long. They are widely distributed over the Atlantic and the Pacific.

Some of the *Lyomeri* attack and swallow fishes larger than themselves. The principle on which their visceral apparatus is built differs from that of other fishes living in the same surroundings and feeding also on large prey.

The distinction in the structure is not due merely to a different degree of development of parts of the visceral elements. The *Lyomeri* differ profoundly from other fishes. The head is divided into two parts: the branchial apparatus is widely separated from the rest of the head, the first branchial arch lying beneath the 12th or 15th vertebra. Parts of the neurocranium are movably joined together, and the cranium can markedly change its shape. The upper jaw is closely connected with the infraorbital sensory canal and articulates medially with the quadrate; it is apparently formed by the infraorbitals fused with the auto-palatine; the maxillary and premaxillary are missing. There is no supraoccipital; there are no bones of the opercular series, no branchiostegals, no basal elements of the branchial and hyoid arches, no cerato- and hypo-hyals. The pectoral fins are pediculate; the left and right sides of the pectoral girdle are completely separated from each other.

Figures illustrating the structure of *Lyomeri* and the way they open their mouths will be demonstrated; and preserved specimens will also be shown. [To be printed in full in *Journal, Zoo'ogy*.]

Mr. C. J. A. BERKELEY. The ovule of *Digitalis purpurea* Linn. (Discussed by Dr. E. Trewavas and Dr. R. Melville.)

Abstract.—

An illustrated account of structural development and a brief discussion of some possible implications of dimensional changes in the parts of the ovule during development. [To be printed in full in *Journal, Botany*.]

FUNGUS INFECTIONS OF THE SKIN.

By Dr. CLARA M. WARREN.

(Plates 1 & 2.)

There has been an increase in the number of cases of ringworm infection in London since the war.

Clinically the diagnosis of a ringworm infection can be made by studying the lesion, but in general the species cannot be identified without a preliminary microscopic examination, and then by culturing hair, pus or skin scraping on a suitable medium.

The history of the patient's occupation, or his association with young animals, particularly with kittens, puppies, calves, horses or rabbits, may be of diagnostic help.

The group of microspora infecting hair are distinguished clinically by characteristic green fluorescence, which can be seen by filtered ultra-violet-light.

Tinea circinata, ringed body lesions, can occur at any age, and are comparable to "fairy rings" on the lawn. The infection is commonly due to *M. felineum*.

Tinea capitis has most often been caused by cat ringworm during the war years, although *M. Audouini* infections still occur, and prove more intractable. Kerion (Nature's method of producing a cure in scalp ringworm), with an acute pustular reaction, has been most often caused by cattle ringworm—*Trichophyton Asteroides*. Favus is fortunately rare in this country, although common in mid-European States. The infection of scalp and hair lasts into adult life, the typical scutula or crusts of mycelia showing clearly.

Occupational ringworm includes ringworm of the beard, a form of Kerion, found in men working with cattle and horses, and "athlete's foot" due to epidermophytosis. *T. Asteroides* also causes eczematous lesions on the fore-arms of land-girls, from leaning against five-barred gates; small boys sit on the gates.

Epidermophyton floccosum has been isolated in most of the cases of foot ringworm recently, although some, associated with lesions elsewhere, have been found to be due to *T. gypseum*.

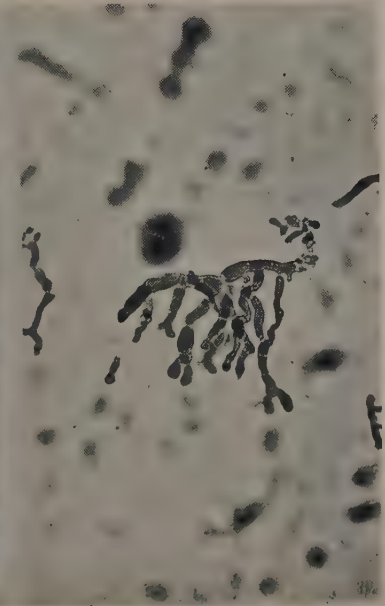
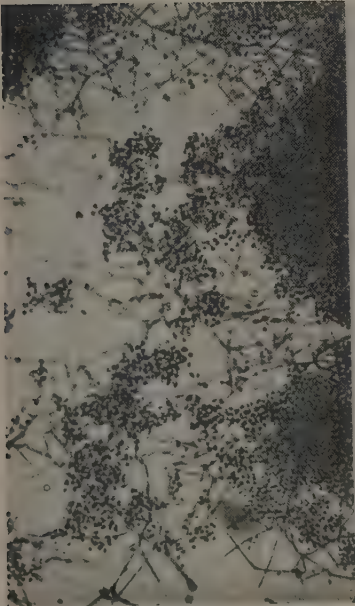
Explanation of the Plates.

PLATE 1.

- Fig. 1. *Trichophyton Asteroides*, cultured from skin in case of *Tinea circinata*. × 264.
 Fig. 2. *Trichophyton gypseum*, cultured from skin of case of 'eczema marginatum' of Sabouraud. × 264.
 Fig. 3. Favus—*Achorion Schonleini*, cultured from infected hair and skin of scalp. × 264.

PLATE 2.

- Fig. 4. *Microsporon felineum*, cultured from infected hair. × 264.
 Fig. 5. *Microsporon Audouini*, cultured from infected hair. × 264.



FUNGUS INFECTIONS OF THE SKIN.

[To face p. 96.



FUNGUS INFECTIONS OF THE SKIN.

PROCEEDINGS OF THE GENERAL MEETING
10 May 1945

Mr. A. D. COTTON, O.B.E., President,
in the chair.

The Proceedings of the General Meeting held on Thursday, 26 April 1945, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Lt.-Col. W. P. C. Tenison, D.S.O., the Muséum National d'Histoire Naturelle, Paris, and the Royal Agricultural Society of England.

The President welcomed the group of Belgian scientists who were present at the Meeting. Dr. V. van Straelen expressed the most sincere thanks of his countrymen.

The President announced that a congratulatory message had been sent to the U.S.S.R. Academy of Sciences, Moscow, on the occasion of its 220th anniversary celebrations.

Certificates of the following candidates for Fellowship were read for the second time : in favour of F. J. Aumonier, M.Sc., M.R.C.S., L.R.C.P., Eric W. Baxter, B.Sc., Thomas E. T. Bond, Ph.D., Brian L. Burt, B.Sc., Dr. Lev Cernosvitov, Alfred C. Cramp, Norman F. Ellison, William David Evans, M.Sc., Ph.D., David W. Goodall, Ph.D., W. B. Gourlay, M.C., M.A., M.B., B.Ch., R. W. Haines, M.B., D.Sc., J. G. Hawkes, M.A., Ph.D., Mrs. Vera Higgins, M.A., J. D. Macdonald, B.Sc. (For.), B.Sc., Miss Lucy B. Moore, M.Sc., Mrs. Minnie Moore, B.Sc., Mrs. Frances Perry, J. A. Pringle, M.Sc., J. Proskauer, B.Sc., J. W. Purseglove, B.Sc., Leonard T. Raeburn, John Grant Roger, B.Sc., Harold V. Rose, Miss Lorna I. Scott, M.Sc., J. B. Scrivenor, I.S.O., M.A., J. R. Sealy, B.Sc., Miss M. V. Thompson, B.Sc., and Thomas G. Tutin, M.A.

Read for the first time certificates of recommendation of the following candidates for Foreign Membership,—Professor Vladimir L. Komarov and Dr. Nils Hjalmar Odhner.

The following communications were read and discussed :—

Miss E. M. BROWN and Miss M. F. SUTTON. Observations on the population of some Emergency Water Supply Tanks, with a description of the life-history of *Corixa panzeri* (Hemiptera Heteroptera). (Discussed by Dr. J. W. Evans, Dr. P. W. Richards, Mr. C. C. Hentschel, Dr. E. Hindle, Mr. D. J. Scourfield and the President ; Miss Brown replied.) [To be printed in full in the Journal, Zoology.]

Mr. A. L. POOLE. An 'Indigenous induced' *Phormium tenax* (Forst.) swamp in New Zealand. (Commented upon by the President.)

Abstract.—

Two species of the liliaceous genus, *Phormium*, occur in New Zealand. Of these *P. tenax* Forst. yields a commercial hard fibre, somewhat similar to 'sisal' obtained from *Agave sisalana*. The main habitat of the plant is in the zoned vegetation around margins of swamps; the zones being, in virgin vegetation, beginning with the dry and proceeding to the wet, semi-swamp forest, swamp scrub, *P. tenax*, *Typha angustifolia*, sedges, free water. It was soon found that partial drainage of these areas induced extensive *Phormium* communities throughout the *Typha* belt and even where drainage was sufficient, to the free water areas. These areas were described by the New Zealand ecologist, Dr. Leonard Cockayne, as 'indigenous induced *Phormium* associations'.

A vegetation survey of such an area is described. The changes in vegetation from the virgin state to the 'induced *Phormium* associations' are traced. Subsequent further changes, brought about by other alterations in drainage and water table conditions, are also traced. These latter are of interest in that exotic species, such as *Festuca arundinacea*, *Glyceria aquatica* and *Bidens tripartita*, have formed communities of limited extent.

The sequence of changes of vegetation illustrate the ecological principle of zonation of swamp vegetation and the control of this by water table conditions. [This paper will be printed in full in the Journal, Botany.]

Mr. I. H. BURKILL. Flies of the family Empididae and other insect-visitors to the flowers of *Tamus communis*. (Discussed by Mr. C. H. Hooper and Dr. R. Melville; Mr. Burkill replied.) [Printed in full, p. 99.]

Dr. R. S. DE ROPP. Plant tissue culture: its application in botanical research. (Discussed by Prof. F. G. Gregory, Dr. E. Hindle, Prof. T. A. Bennet-Clark; Dr. de Ropp replied.)

Abstract.—

The cultivation of plant organs and tissues *in vitro* was first attempted by Haberlandt and developed later by Robbins, Gautheret and White. The method has been applied to the study of (1) the nutrition of various plant organs, (2) certain physiological processes such as the respiration of isolated plant cells, development of root pressure, etc., (3) the morphogenesis and regeneration of plant organs, (4) nature of the malignant changes in plant cells developed under the influence of *Pseudomonas tumefaciens*, (5) the effect of viruses on isolated plant roots.

Outstanding amongst the discoveries which have been made by this method are (1) the capacity of isolated plant roots to grow indefinitely in suitable culture media, (2) the importance of the vitamins thiamin, pyridoxine and nicotinic acid for the growth of such roots, (3) the rôle of various mineral elements in root growth, (4) the magnitude of root pressure and its diurnal variation, (5) the capacity of isolated cambial tissue to grow indefinitely without differentiation, (6) the rôle of oxygen gradients in inducing differentiation in callus cultures, (7) the stimulating effect of roots on the growth of stems and leaves, (8) the potentially unlimited growth of isolated stems, (9) the permanency of the malignant change in bacteria-free crown gall tissue. A brief account will be given of further potential applications of the method.

FLIES OF THE FAMILY EMPIDIDAE AND OTHER INSECT-VISITORS TO THE FLOWERS OF TAMUS COMMUNIS.

By I. H. BURKILL.

When I drew together the list which is below, of insects observed on the flowers of the Black Bryony, *Tamus communis* Linn., I was struck by the prominence of Empid flies in it and I remembered that Brenner in the 'Verhandlungen der Naturforschende Gesellschaft in Basel' (XXIII, p. 127; 1912) had stated that an Empid, which he described in words applicable to the common *Empis livida*, is a frequent visitor in Switzerland to the flowers which he says it pollinates: and it appears to me desirable to call the attention of entomologists as well as botanists to this in the hope that confirmation of the flower-insect relationship may be forthcoming from those able to watch the plant in localities not easily accessible to me.

Empids are among the insects which feed on plant juices, such as nectar, and fortify the system by resort to animal food at the time of reproduction: thus the male insect in certain species has the habit of catching and killing some small insect which is offered to the female; also in certain species the female catches insects for herself. As enabling Empids so to slay and to drain they possess a cylindrical tongue quite as effective for driving into a nectary as into the body of the prey, and long enough to enable the insect to reach the nectar-carrying base of such a flower as *Tamus* with its half-hidden nectar, as to gain success in combat among resisting legs and wings and jaws. The list holds the names of eleven Empids.

The list also holds the names of other biting insects. Firstly, there is an observation kindly put at my service by Mr. E. A. Ellis of the Castle Museum, Norwich, to the effect that on the night of 17-18 June, 1939, between midnight and 1 a.m., he saw numerous males of the mosquito *Anopheles claviger* in *Tamus* flowers. Secondly, there is a Hemipteron in the list,—*Anthocoris nemorum*, an insect which has many food-plants and having arrived on a plant of *Tamus* is prepared to seek the flowers to feed. Thirdly, there is a Thrips which has *Tamus* as its food-plant and when the flowers are open it resorts most particularly to them to drive its mouth parts into the inner surface to feed. Within the writer's experience, no other insect is equally abundant in the flowers, and it is very active. Lest readers who know that flower-biologists have classified Thrips in a lump as bad, *i. e.*, as dystopous, reference may be made to Annand's paper in 'The American Naturalist' (LX, pp. 177-182: 1926), where effective pollen-carrying by a member of the family is demonstrated.

Insects which lick the surfaces of nectaries, such as butterflies, bees, Syrphids and most of the Muscids, seem to be on the whole less frequent visitors than the tissue-penetrating insects above.

The male flower of *Tamus* is a rather shallow cup, the female a shallow saucer, which by facing earthwards ask a little adroitness of the insect which visits them. The base of the flowers is lined by a very small-celled epidermis, the cell-walls being rather thick, and the underlying parenchyma is without the appearance of being nutrient; but right in the centre this epidermis is replaced by tall cells which stain freely and are apparently

full of nutrient material, and here must be the tissue that the insects like. The flowers are definitely scented. There are sixty males to every female and as there is no parthenogenesis, but a necessity for the transmission of pollen from the male plant to the female, and as abundant fruit is set, it is clearly demonstrated that, at sixty to one, insect agency is adequate for the plant.

A last remark :—I do not find under the base of the flower in my sections any of the raphides-mucilage cells which apparently have a protective rôle in the general tissues.

The following is the list of visitors. In giving it I express my grateful thanks for determinations to Messrs. R. B. Benson, W. F. China, L. R. Coe, N. D. Riley, Dr. K. G. Blair, and Dr. F. I. van Emden. Abbreviations in the list :—sh., sucking nectar ; cp., collecting pollen ; fp., feeding on pollen. Brenner is quoted from Kirchner, Loew and Schroeter, *Lebensgeschichte der Blütenpflanzen Mitteleuropas*, 1/3 p. 671 (1930), and Félix Plateau from Bulletin de l'Académie Royale des Sciences de Belgique, ser. 3, XXXIV, p. 628 (1897). The insects are assorted under the terms eutropous or decidedly favourable to plants as flower-visitors ; hemitropous or favourable ; allotropous or indifferent ; and dystropous or injurious.

HYMENOPTERA.—Eutropous and long-tongued. **Apidae** : (1) *Apis mellifera* L. may be seen on the flowers year by year in Britain, but is rare ; it visits either sex methodically when it visits at all ; it is recorded as a visitor in Switzerland by Brenner and in Belgium by Plateau. (2) *Bombus terrestris* L. on ♂ in Surrey, rare, sh. and cp. (3) *Bombus* sp. or spp. in Surrey, as the last. Eutropous, and with tongues of mid-length. (4) *Anthrena* sp., seen on both sexes, in Surrey, as a rare visitor, but when visiting methodic and smothered in pollen. (5) *Anthrena* sp. in Belgium (Plateau, who records no more than that it was a species of small size which he saw). (6) *Halictus tumulorum* L. on ♂ in Surrey, rare. (7) *Nomada lineola* Penz. on ♂ in Surrey. Allotropous and with short tongues. **CYNIPIDAE**. (8) *Synergus* sp. on ♂, once, in Surrey, sh. **BRACONIDAE** : (9) an undetermined sp. on ♂ in Surrey, once. **TENTHREDINIDAE** : (10) *Cladius pectinicornis* Geoff. on ♂, once in Surrey, sh.

LEPIDOPTERA.—Hemitropous and mid-tongued. **Tortricina**. **PHALONIIDAE** : (11) *Phalonia nana* Haw., at Surlingham, Norfolk (*E. A. Ellis*). **Tineina**. (12) An undetermined sp. on ♂, Ashbourne, Derbyshire, once. **PLUTELLIDAE** : (13) *Glyphipteryx schoenicolella* Boyd, on both sexes in great abundance, sh., near Leatherhead by the side of a field full of *Dactylis glomerata*, which is the insect's larval food-plant.

DIPTERA.—Hemitropous and mid-tongued on the whole. **SYRPHIDAE** : (14) *Syrphus aureicollis* Meig. on ♂ once in Surrey, sh. **EMPIDIDAE** : (15) *Empis tessellata* F. on both sexes in Surrey, but chiefly on the ♂, in abundance at the commencement of the plant's flowering season, sh. ; its tongue is 3 mm. long, and this and the front of its face come into contact with the sexual organs of the plant ; at the same time its legs rest on the sexual organs of flowers neighbouring that actually being visited. (16) *E. livida* L. on both sexes in Surrey in the later part of the plant's flowering season, sh. ; the tongue is 2 mm. long, and the insect is likely to pollinate better than the preceding Empid. (17)

E. trigramma Meig. plentiful in Surrey on the flowers of both sexes but chiefly on the ♂, from the middle to the end of the season ; it is a slightly smaller insect than the last, but with an almost equally long tongue which makes it a suitable pollinator. (18) *E. nigratarsis* Meig., on both sexes, but chiefly on the ♂, in Surrey at the middle of the season, sh. (19) *E. nuntia* Meig. on both sexes, with the last ; its tongue a trifle longer, but not so long that the insect when feeding has its head above the sexual organs of the plant. (20) *E. aestiva* Lw. in some years very plentiful, as in 1942, on the flowers of both sexes in Surrey, sh. (21) *E. praevia* Collin, on male flowers, a small weak insect, rare, sh. by pushing its body down below the sexual organs of the plant. (22) *E. sp.* undetermined, on ♂, Ashbourne in Derbyshire, sh. (23) *E. sp.* recorded by Brenner as an insect with a body 6 mm. long (*i. e.*, of the size of *E. livida*), eagerly visiting the flowers of both sexes in northern Switzerland. (24) *Rhamphomyia longipes* Meig. on flowers of both sexes, sh. in Surrey freely. (25) *Microphorus anomalus* Meig. on ♂, at the end of the season in Surrey, sh. Allotropic and short tongued. BIBIONIDAE: (26) *Dilophis femoratus* Meig. rather common in Surrey, chiefly on ♂, at the commencement of the flowering season, sh. ; a weak insect which pushes its way down the flower cup ; both sexes of the insect do this. MYCETOPHILIDAE: (27) *Asindulum flavum* Winn. in Surrey on flowers of both sexes but chiefly on ♂, rather frequent in woodland glades ; the tongue of this fungus-gnat is suitable for probing but would not seem likely to penetrate the plant-tissues ; its labia are lanceolate-ovate and suitable for applying to surfaces ; it may be as efficient as *Empis nuntia* as a pollinator. CULICIDAE: (28) *Anopheles claviger* Meig., the male insects, at Surlingham, Norfolk, in June 1939 (*E. A. Ellis*). TACHINIDAE: (29) *Echinomyia fera* L. on ♂ in 1942 and again in 1943, but rare, in Surrey, sh. (30) *Phorocera caesifrons* Macq. on ♂ in Surrey, sh. (31) *Actia crassicornis* Meig. occasional on ♂ in Surrey, sh. (32) *Actia pilipennis* Fall. on ♀ in Surrey, sh. MUSCIDAE: (33) *Calliphora vomitoria* L. on ♂ in Surrey, but rare ; in Belgium (Plateau without any details). (34) *Lucilia sp.* on ♂, in Surrey, now and then, sh. ANTHOMYIIDAE: (35) *Hylemyia radicum* L. on ♂, in Surrey, sh. (36) *Phaonia serva* Meig. on ♂, in Surrey, early in the season, sh. CORDYLURIDAE: (37) *Scatophaga stercoraria* L. occasionally on ♂ in Surrey, if not sh. then seeking insects at the base of the flower. ORTALIDAE: (38) *Platystoma seminationis* F. seen thrice on ♂ in Surrey, but not at all on ♀, sh. Undetermined small flies recorded by Plateau as visitors in Belgium, no details added

COLEOPTERA.—Allotropic and without extension of the mouth-parts. ELATERIDAE: (39) *Agriotis acuminatus* Steph. once on ♂ in Surrey. CANTHARIDAE: (40) *Cantharis pellucida* F. on ♀ in Surrey but rare, sh. NITIDULIDAE: (41) *Meligethes atratus* Ol. on ♂ in Surrey, occasional at nectar. SCARABAEIDAE: (42) *Phyllopertha horticola* L. on ♂ in Surrey, rare, sh. (43) *Trichius abdominalis* Mén. in Belgium (Plateau). DYSTROPOUS and without extension of the mouth-parts. MORDELLIDAE: (44) *Anaspis maculata* Frc., exceedingly abundant on male flowers where it devours the pollen and only on ♀ by accident ; sometimes it pushes its way down to the base of the flower where perhaps it finds nectar ; an injurious insect. STAPHYLINIDAE: (45) *Anthobium*

ophthalmicum Payk. eating pollen on ♂ in considerable abundance in Surrey and in Devon, and like the last an injurious insect.

HEMIPTERA.—Allotropous and with tongue of mid length to long.

ANTHOCORIDAE: (46) *Anthocoris nemorum* L. on ♂ in Surrey rather unusual, seeking nectaries.

NEUROPTERA.—Hemitropous with tongue of mid-length. PANORPIDAE: (47) *Panorpa communis* L.; this insect, the common Scorpion fly, is very plentiful on *Tamus* plants in Surrey, wandering and feeding at flowers when it comes across them; it has been seen on flowers of both sexes; but its habits make it an indifferent pollinator.

THYSANOPTERA.—Usually classed as dystropous, but in this case not so. The mouth-parts are so small that the insect's body comes into contact with the tissue where it feeds. (48) *Anaphothrips tamicola* Bagnall, was described from specimens taken on *Tamus* in southern France and is very plentiful on it in Britain, feeding on the tissues and particularly within the flowers, moving freely from one flower to another, and one plant to another.

OBITUARIES.

By the death of Professor EUGÈNE-LOUIS BOUVIER on 14 January 1944, in his eighty-eighth year, France loses one of her best known personalities in the scientific world of Paris, and also one of her most distinguished zoologists. Professor Bouvier, and old student of Edmond Perrier, began his active career at a time when evolutionary doctrines were still being contested and he belonged to the older generation of naturalists who seemed to possess an almost encyclopedic knowledge of the animal kingdom. Moreover, his researches, extending over half a century, were conducted on a great variety of subjects with an enthusiasm that never left him, and which extended to those with whom he came in contact.

He was born at Saint-Laurent-Grandvaux, in the Province of Jura, on 9 April 1856, and became a teacher at a small village school in his native Province. Subsequently he was sent to the primary school at Versailles and eventually to the École Normale Supérieure at Saint Cloud, where his qualities attracted the attention of Edmond Perrier. As a result, in 1883 he was admitted as a bursar at the Muséum national d'Histoire naturelle at Paris and during the next five years studied various branches of natural science, gaining his doctorate in 1887. Two years later, in 1889, he was appointed professor at the School of Pharmacy in Paris. This rapid advancement was followed in 1895 by his nomination to the Chair of Articulate Animals, at the Muséum national d'Histoire naturelle, where he remained for thirty-six years. Subsequently his chair was subdivided and he continued as Professor of Entomology. In 1902 he became a member of the Académie des Sciences and President in 1925. He was also Vice-President of the French Academy of Agriculture and received numerous distinctions both at home and abroad. He was elected a foreign member of the Linnean Society in 1904, and of the Zoological Society of London in 1921. A Jubilee Volume in his honour was published in 1936, prepared by seventy-four of his former colleagues, pupils and friends, "en hommage de leur affectueuse admiration."

Bouvier's earlier work was devoted to studies on the affinities of various groups of animals, based on their anatomy and comparative morphology. His first thesis, published in 1887, dealt with the classification and general anatomy of the sub-class Prosobranchia (*Streptoneura*), and in this and subsequent memoirs he worked out the relationships of various groups of Mollusca based mainly on a study of their nervous system, but also on their palaeontology. In vertebrates he contributed an important thesis on the anatomy of Cetacea. His monograph on *Peripatus*, published in 1907, included descriptions of all known species and their relationships. His researches on Decapod Crustacea, begun soon after joining the museum, were continued until the end of his life, Bouvier's last work, published in 1942 in the *Mémoires de l'Académie des Sciences*, being devoted to a description of the *Corystoidea*, and the evidence for regarding them as the most primitive examples of the *Brachyura*. His important monograph on the *Atyidae* comprised studies on evolutionary mutations, in addition to details of the classification and distribution of these freshwater Decapoda. He also completed a monograph on the *Pycnogonida*, based to a large extent on the collections of the *Français* and the *Pourquoi-Pas*.

When on a visit to Plymouth, in 1913, he made the interesting discovery of the transformation of the *Phyllosome* larva into the *Puerulus* stage of the spiny lobster, *Palinurus*.

Bouvier first became interested in the habits of certain Hymenoptera about 1900 and published studies on the psychology of *Bembex* and *Philanthes*.

In later years he devoted most of his time to entomology and attracted a group of first class entomologists to the museum. He built up a gallery of applied entomology, and in 1917 when his chair was subdivided retained the title of Professor of Entomology. He published various general works on this subject including:—‘*La vie psychique des Insectes*’, ‘*Habitudes et métamorphoses des Insectes*’ and ‘*Le communisme chez les Insectes*.’ The first of these, perhaps his best known popular work, was written during the last war when he lost two of his children. Dr. L. O. Howard, who translated ‘*The Psychic Life of Insects*,’ records that it was written in the effort, to use Bouvier's own words, ‘*pour oublier les angoisses de patriote et de père*.’

After retiring from the Museum, he continued to work on insects, especially Lepidoptera, and from 1931 to 1938 published six memoirs on the *Saturniinae*. Towards the end of his life, he returned to his interest in Crustacea and in 1940 completed the 37th volume (on Decapoda) in the ‘*Faune de France*’, of which he was one of the promoters. He was also editor of the Zoological section of the *Annales des Sciences Naturelles*.

E. HINDLE.

JEAN FERNAND CAIUS was born on 17 January 1877, at Saint-Seurin-de-Cadourne, in the district of Lasparre, in the Department of Gironde, France.

The Caius family moved from the birthplace of Jean to Toulouse in 1884. At Toulouse he began his early education with the Christian Brothers and later at ‘*le petit séminaire*’, a school staffed by priests, and finally, he joined the Apostolic School of Bordeaux, an institution intended

for lads preparing for the priesthood. He entered the Society of Jesus on the 15 November 1895. Almost a month later, the young Jesuit landed at Tuticorin on the 13 December 1895. He spent his first five years (1895-1900) in the Sacred Heart College, at Shembaganur, situated in the delightful surroundings of the Palni Hills, Southern India. Young Caius still had to travel much in preparation for the great day when he would be ordained priest. From Shembaganur he went to Kurseong, but soon after, for reasons of health, he found himself bound for Europe once more. He finished his theological studies in St. Beuno's College, St. Asaph, N. Wales. He was finally ordained on the 26 July 1908 at Milton Park, Dublin. Between October 1908 and early 1911 he spent much of his time on the Continent and he returned to India about the middle of the same year. He was then appointed Professor of Chemistry at St. Joseph's College, Trichinopoly, where he remained till he was transferred in 1922 to St. Xavier's College, Bombay.

By this time Caius had already established for himself a name in the field of bio-chemistry. At St. Xavier's he met Rev. E. Blatter, the botanist, and the two soon became fast friends. At about the same time as Caius arrived in Bombay, Dr. Mhaskar, his friend and collaborator in the south, also arrived in the town.

At this time a Government scheme to establish a Pharmacological Laboratory in Bombay Province was under way and Government were in search of a man to take charge of the department. The laboratory was temporarily housed in a corner of the Haffkine Institute, and Caius was selected as head of the department. Soon Dr. Mhaskar was by his side and the work went on merrily. Results were piling up—But to what purpose? 1933 saw Caius in his fifty-fifth year and the rigid Government rule for retirement was applied—this 'axe' not only terminated Caius' services but the laboratory as well.

In 1927 Caius was appointed on the Drugs Enquiry Committee. During the absence of the Chairman, Caius filled with distinction this honoured place. Overwork was now beginning to tell.

In 1930 Blatter, Caius and Mhaskar undertook the revision of the 'Indian Medicinal Plants', by Kirtikar and Basu. Each tackled his part of the work with untiring labour, but Blatter was by now an ailing man. Caius realized this, and feared that the work might be interrupted: though loath to leave his cubicle, he packed his boxes with all his manuscripts and joined Blatter at Panchgani. This visit strangely revived the energy of Blatter, and the two friends worked together till the work was completed. It had taken them three years.

Caius wrote freely on scientific subjects both for the scientist and the layman, and numerous articles under his name have appeared in various periodicals. He was a co-editor of the 'Journal of the Bombay Natural History Society' for several years and was also its war-time Honorary Secretary until his death. He also represented the Bombay Natural History Society on the Board of Trustees of the Prince of Wales Museum of Western India, Bombay, and was the Chairman of the Natural History Section Committee, of this Museum to the end. He was an ardent patriot and a de Gaullist and took a lively interest in the work of the Free French Committee.

Behind a somewhat stern appearance was hidden a charming character. Caius was full of fun and had a ready wit. His love for the poor and feeling for human suffering was always uppermost in his mind and he took every opportunity of relieving distress. He suffered from cancer of the branchiae which finally hastened his end. He bore his suffering with great fortitude. The end came on the 27 July 1944, which he met peacefully.

May his soul rest in peace !

CHARLES McCANN.

Lieutenant Colonel ANDREW THOMAS GAGE, C.I.E., M.A., B.Sc., M.B., LL.D., was born on 14 December 1871 and was a native of Aberdeen. He went to the Grammar School in Old Aberdeen and afterwards to King's College where he took his M.A. and B.Sc. degrees and at Marischal College he obtained his M.B. degree. Immediately after graduating in medicine Gage became assistant to Professor J. W. H. Trail in the Department of Botany at Aberdeen University, and he held this post from 1894 until he entered the Indian Medical Service in 1897. His early life, training and experience and his close association with Trail foreshadow in a remarkable way his subsequent career, for Gage was to succeed Sir George King and Sir David Prain as Director of the Botanical Survey of India and Superintendent of the Royal Botanic Garden, Calcutta. Both King and Prain were close friends of Trail, and when Sir George, then a Brigadier-Surgeon, was at home on furlough from India, he asked Trail to find him a young medical man with a leaning towards Botany who could be induced to enter the Indian Medical Service ; Trail passed on the suggestion to Prain, who served under King and afterwards succeeded him ; and likewise Trail was responsible for guiding Gage in the same direction.

Gage, when he arrived in India, was sent to the North West Frontier as surgeon to a native regiment, but he was not long on military service for his "leaning towards botany" had already marked him for other duty. When, in 1898, King retired from India and Prain was appointed Director of the Botanical Survey of India and Superintendent of the Royal Botanic Garden, Calcutta, Gage was elected to succeed Prain as Curator of the Calcutta Herbarium.

In 1900 he married Jean Stuart Bruce of Kildrummy who survives him ; they had one child who died in infancy.

Soon after his appointment to the Curatorship, Gage was deputed to explore the remote Lushai Hills, a region then botanically quite unknown. He travelled from Chittagong up the Karnafuli River by dug-out canoe to Rangamati and on through the inhospitable Chittagong Hill Tracts to Demagiri whence he took the bridle path to Fort Lungley. The plants he collected proved to be of much interest and a short account of his journey, together with a list of the plants he collected, is published in the first volume of the Records of the Botanical Survey of India (vol. I, no. 13, 1901).

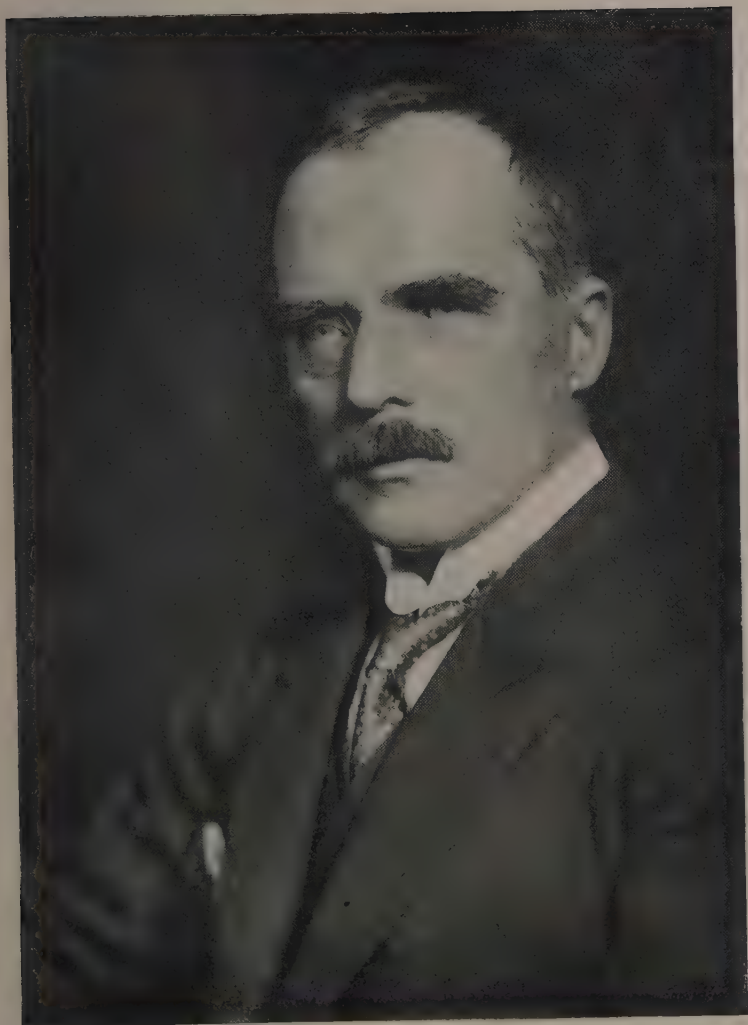
Routine work in the Herbarium occupies much of the Curator's time, but in 1903 Gage set out on a further botanical tour. This time he visited Burma with the object of making an intensive study of the vegetation of the drier 'desert' zone, of which little was known. The District of Minbu was chosen as typical and the plants collected in the area were determined by Gage. In his account of this expedition (Rec.

Bot. Survey Ind. vol. **III**, pp. 1-141, 1904) little notice is taken of the uncertainty of travel in these regions about this time, but the obstacles to plant collecting can well be illustrated by the experiences of an Indian collector, who was sent the following year to extend Gage's work by gathering material from the neighbouring district of Pakokku. The inhabitants considered the operations of the plant collector to be of an offensive character connected in some mysterious way with the poisoning of wells, with the result, it is recorded, that collecting in Pakokku came to an abrupt conclusion.

Gage at various times from 1900 onwards officiated for Prain when he was on leave from India and, when Prain retired in 1905 to become Director of Kew, Gage was appointed his successor.

His first work as Superintendent of the Botanic Garden was the compilation of a catalogue of all the trees and shrubs in the garden. Catalogues had been published from time to time, from Roxburgh's 'Hortus Bengalensis' to Anderson's Catalogue in 1865, the latest revision having been made in 1871. The Garden is divided into geographical regions in which the plants are distributed according to their country of origin. This arrangement and the extent of the garden, which is over 270 acres, made the finding of a particular plant a matter of no little difficulty in the absence of an up-to-date list, especially as many of the labels had been lost; thereby the exchange of seeds and the providing of material required by institutions in India and in other countries were greatly hampered. In making his catalogue the aim Gage had in view was to have every plant located, correctly named and marked in order to facilitate the finding of a plant itself and its name. Accordingly he arranged for the Garden to be specially surveyed and for a map to be prepared. The map was divided into squares of 100 ft. and the location of the squares on the ground was fixed by short iron posts let into brick foundations. The posts were inconspicuous, one permanent post to every 3 acres being found to suffice. The compilation of the catalogue was a long and laborious undertaking faithfully fulfilled, for the identification of every plant was carefully verified; in all some 17,000 plants were checked, determined and labelled. The work, which was begun in 1909, took three years to complete and the catalogue was duly published (Rec. Bot. Survey Ind. vol. **V**, nos. 1, 2 and 3, pp. 1-274, 1911; vol. **V**, no. 4 pp. 275-367, 1912).

Afterwards heavy administrative duties left Gage comparatively little freedom for purely systematic work, but from time to time he published short papers, the most noteworthy dealing with the Euphorbiaceae (Rec. Bot. Survey Ind. vol. **IX**, no. 2, 1922 and Kew Bull. 1914) and the Genus *Polygonum* (Rec. Bot. Survey Ind. vol. **II**, no. 5, 1903). It may be worth noting the anxieties which attend the Superintendent of a Botanic Garden in the tropics, often revealed in Gage's Annual Reports. The contrasts of climate and the ravages of storm which may be suffered in a single season, can be illustrated from my own experience in 1927. During the early summer a drought caused many plants to die, dust storms being frequent. In May a cyclone which lasted for a few minutes levelled 500 trees. The following morning a downpour converted the garden into a



Lt.-Col. ANDREW THOMAS GAGE, C.I.E.

lake interspersed with a few islands. Add to this the most luxurious growth of grass and weeds that follows the monsoon, the bursting of the river banks by a tidal wave, the lakes becoming infested with crocodiles and an outbreak of cholera amongst the labour force and you have a somewhat exceptional but none the less a more or less normal season.

Gage took a particular interest in economic problems relating to plants; among his early papers is one on the diseases of sugar cane in Bengal. As Director of the Botanical Survey of India he held charge of the Industrial Section of the Indian Museum, which—carrying on the magnificent work initiated by the late Sir George Watt—performs the functions of an Intelligence Bureau for information on plants in matters connected with their economic importance.

In this connection Gage's investigations and reports cover a wide and varied field on subjects such as the growing of flax for fibre, the improvement of Indian cotton, the utilization of Indian timber for railway sleepers and the manufacture of wood pulp for paper making. Most of his interest lay in the sources and supply of medicinal products. During the first Great War the shortage of drugs led to the investigation and experimental cultivation of indigenous plants of reputed medicinal value, as well as to the cultivation on a considerable scale of standard drug-yielding species. For example, in connection with leprosy investigations undertaken by Sir Leonard Rogers, arrangements were made to collect throughout the Chittagong District and Chittagong Hill Tracts seeds from which Chaulmoogra oil is prepared. Large quantities of seed both of the true Chaulmoogra (*Taraktogenos (Hydnocarpus) Kurzii*) and of the false Chaulmoogra (*Gynocardia odorata* and *Hydnocarpus venenata*) were collected. Official rhubarb was scarce and the possibilities of using the rhizomes of *Rheum nobile* and of *Rh. acuminatum* were explored. The roots of *Bergenia purpurascens* were collected to test their efficacy in the relief of dysentery. *Hyoscyamus* sp., *Cannabis*, *Strychnos*, *Podophyllum Emodi* were also subjects of extended investigation, as well as *Fragaria vesca*, the wild strawberry, of which the roots are used by Kashmir villagers as a substitute for coffee. Among species cultivated experimentally were *Atropa Belladonna* and species of *Chenopodium*—*Ch. ambrosioides* and *Ch. anthelminticum*—from which an oil used in the treatment of hook-worm is obtained. *Digitalis*, *Ipecacuanha* and *Lycopodium* (the latter for the supply of spores for coating pills) were all grown on a considerable scale.

As Director of the Botanical Survey and as Superintendent of Cinchona Cultivation in Bengal, Gage was responsible, not only for the extensive Government Cinchona Plantations in Bengal and later in Burma, but also for the manufacture and distribution of quinine and febrifuge throughout India. To the increased production of quinine and to problems connected therewith Gage devoted the later years of his service in India. The yield of quinine from the long established plantations in Bengal and in Madras has never been sufficient to meet the needs of India, and during the Great War the shortage of quinine was acute, although home-grown supplies had been supplemented by large reserves of bark and of quinine sulphate purchased from Java. The Government of India, realizing the seriousness of the position, called for a campaign to increase the areas under Cinchona,

and in 1917 Gage set out to tour the whole of India and of Burma with a view to discovering new regions where *Cinchona* might successfully be cultivated. His report is of great interest and value. When the time came to select a site for a new plantation, Gage's choice of Southern Burma appears in the light of later knowledge to have been unfortunate, but suitable land in the neighbourhood of the existing Government plantations in Bengal and in Madras was mostly agricultural or under tea or had been planted with forest crops. His choice was influenced by the fact that in Southern Burma unlimited virgin forest was available, whereas in all other regions where the essential conditions of soil, elevation and climate seemed to be fulfilled, planting would be restricted by lack of suitable land. Accordingly plants were carefully transplanted in Wardian cases from India to Burma and nurseries were started on the flank of a tributary of the Heinzee river in the Tavoy District. The misfortunes which attended the enterprise may be related. In the three months, June, July and August 1921, the year after the nurseries had been established, the rainfall amounted to over 240 inches. More than half the plants succumbed to the unexpected heavy rainfall—from eleven to as much as sixteen inches were recorded in twenty-four hours—with the result that the site had to be abandoned. Another area further south was then chosen, at Nyaungbinkwin some ten miles from the borders of Siam and some 120 miles up the Tenasserim river from Mergui. Roads were cut into the jungle, a camp was established and labour was brought over from Darjeeling. In the early stages the seedlings thrived well, the bark was found to contain a high percentage of alkaloids and there was freedom from disease, while *Helopeltis*, the insect pest of the Darjeeling plantations, was not serious. But the hopes of early years soon gave place to misgivings and anxiety. A mysterious collar disease appeared and though no fungus could be found the plants wilted and died. Every effort was made to make the enterprise a success and planting and replanting continued for some years, but the plantation had eventually to be abandoned in 1936. Nyaunbinkwin recalls unpleasant memories. I have never been so distressed by the sun elsewhere. In the shade of the jungle one could walk all day without undue discomfort but in the open the heat was so intense that even the labour force, accustomed to the sun, had to cease work for four or five hours around mid-day. The difference in temperature in the shade of the jungle and in the open and the effect of the sun on the soil could scarcely have been foretold when the jungle had not been cleared, and I think there is little doubt that high sun temperatures were the main cause of failure. It was a great disappointment to Gage that this experiment, to which he devoted most of the later years of his service, was not the success he had hoped. Had results been otherwise it might have solved the *Cinchona* problem for India.

Gage was awarded a C.I.E. in 1923 and he retired from India in May 1925. He was on furlough prior to retirement; and from 1924 to 1929 he was Librarian and Assistant Secretary to the Linnean Society, when for the last two years of that period Mrs. Gage and he lived at Burlington House. It was during those and subsequent years that he completed his 'History of the Linnean Society of London' which was published in 1938. For the descriptive, well drawn narrative of the foundation, traditions,

and annals of the Society, the Fellows will ever remain deeply in his debt. In 1935 the University of Aberdeen, his own university, honoured him with the degree of LL.D.

One of Gage's marked characteristics was his devotion to his official duties with the result that he had few outside interests as far as sport and amusement are concerned. He was, however, very keen on motoring and was among the earliest users of a car in Calcutta ; never content if his car was not tuned to perfect running.

His medical knowledge was kept up to date scrupulously and he was ready with his services whenever there was occasion. The scanty leisure permitted him by official routine was usually occupied in his library which was abreast of the times in medicine and in science.

Both in India and at home he had many friends to whom he endeared himself by his generous and kindly personality.

Gage after a long illness patiently borne in the quiet of the Drumnadrochit hills and of Deeside died at Strathpeffer on 21 January 1945.

J. MACQUEEN COWAN.

When, in the autumn of 1924, Colonel Gage began his work in the newly-created position of Librarian and Assistant Secretary, the Society was at once influenced by his kindly but decisive personality. At first circumstances made it difficult for him to undertake any general reorganization of the Society's ways of conducting its business ; but from the start he set about bringing the Library into better order, beginning with a detailed register of periodicals received, which is still in use today, and plans for a subject-catalogue. Everything he undertook he did with the same characteristic thoroughness ; and there is but little doubt that during the five years the Society had the benefit of his wide experience in administration, improvement was evident in many ways. During that period, which was immediately before the era of world depression, the Society had reached its highest number of Fellows (just short of 800), its Meetings and social functions were crowded affairs, and its publications many. Unfortunately, however, Colonel Gage's health began to give him some concern, and as time went on it became more and more doubtful whether he could continue to work in London. In an endeavour to carry on, he became resident at the Society, but after two years resigned office, at the end of October 1929, and went first to Bognor Regis and later to Scotland.

During the last two years of his service he had been gathering materials for his History of the Society, published in 1938. In spite of continued ill-health, involving a serious major operation, he continued his work on the History for years after his resignation. This History has been widely appreciated for its excellent qualities, both as a selection of thoroughly verified facts and for the manner of their presentation.

As head of a staff Colonel Gage was greatly liked and respected. His warm humanity and sense of humour, his philosophical outlook on life and his consideration for others, saved him from the least taint of that unfairness to subordinates which sometimes mars the work of an otherwise good administrator. I feel sure that all who served under Colonel Gage counted it an honour to have done so.

S. SAVAGE.

The death of Col. M. J. GODFERY, R.A.S.C., at Torquay on 9 April 1945, in his eighty-ninth year, was a great loss to British and European botany. He was our first authority on orchids. In 1933 the Cambridge University Press published his sumptuous 'Monograph and Iconograph of Native British Orchidaceae'. This was splendidly illustrated by fifty-seven coloured plates from water-colour drawings by Mrs. Hilda Godfery, without whose help, Col. Godfery said, the work could never have been written.

Great attention was paid to the taxonomy of the family. Mr. P. M. Hall in a review in Rep. Bot. Exch. Club says, 'Col. Godfery has provided a taxonomy of our British genera and species, which differs from any arrangement which will be found in any list or text-book, British or Continental. This arrangement, however, is rational and carefully worked out along the lines of probable evolution.'

Of the two great divisions of the Orchidaceae, the Monandreae and Diandreae, only one genus, *Cypripedium*, belongs to the Diandreae. It is estimated that the Monandreae contain more than 500 genera; and as there are many parallel lines of evolution, it is clear that the British genera cannot show a continuous evolutionary sequence. The order in which Col. Godfery proposes to arrange the genera is intended to follow, as far as possible, the sequence of the evolution of the rostellum from the simplest to the more elaborate forms.

As to the naming of the Spotted Orchids, he considers that the woodland form, named by Druce as *O. Fuchsii*, is the true *O. maculata* of Linnaeus. The heath form, which most British botanists name as subsp. *ericetorum* Linton, he takes to be *O. elodes* of Grisebach.

Col. Godfery described a number of rare hybrids, and at least one new British species, *Epipactis leptochila*, and one European, *Serapias gregaria*. His most interesting contribution to general botany was his confirmation of the work of Monsieur M. Pouyanne on the fertilization of the genus *Ophrys*. This quite sensational work was carried out in Algeria, especially on *Ophrys speculum*, which does not grow in Europe, except for a few solitary plants. Col. Godfery was able to confirm and extend M. Pouyanne's findings, owing to his long residence in Hyères, which is a very fine station for species of *Ophrys*. The relations of the insects (mostly flies) which affect the fertilization, to the flowers, is very complicated, and has to be studied to be believed. Many of these insects Col. Godfery was able to identify, and drawings of these are reproduced in the Iconograph. Col. Godfery's work on orchids was embodied in more than forty papers contributed to the 'Journal of Botany' between 1914 and 1931. About twenty papers were contributed to the 'Orchid Review'. He also contributed to the Bulletin of the American Orchid Society, edited by Okes Ames. His last botanical writing was to this work, in 1940, on Floral Cupboards. Increasing infirmities, especially of sight, restricted his botanical activities and cut him off from assessing the numerous additions to British orchids since 1931.

The drawings of Mrs. Godfrey from which the coloured plates have been taken, are to go to the British Museum (Natural History), together with a great many more drawings of species from S. Europe. Amongst them are several drawings of rare hybrids. It is to be hoped that students of

orchids will study these, for no description can possibly convey the effect of the living plant so well as these drawings. In the case of hybrids it is on a delicate balance of form and colour that their identification so often depends.

Colonel Godfery was elected a Fellow of the Linnean Society on 17 June 1915.

T. STEPHENSON.

It will be with the deepest regret that botanists, and especially the bryologists of Norfolk and Yorkshire, will have learned of the death of WILLIAM HOLMES BURRELL on 30 March 1945. (1865-1945)

Mr. Burrell was born in London and as a boy attended St. Mark's College, Chelsea. Later his family moved to Norfolk, where he was apprenticed to Mr. Crooke, chemist, of Holt; from here he transferred to Sheerness and qualified as a pharmaceutical chemist in 1886. He held a post in London for a time, but for 20 years of his professional life he conducted his own business at Sheringham. On retirement he moved to Norwich, where he devoted much of his time to field botany—the subject nearest his heart. During this period he worked in collaboration with the late W. G. Clarke on the distribution of plants in the county, and in the 'Flora of Norfolk' which was published in 1914 under the auspices of the Norfolk and Norwich Naturalists' Society under the editorship of W. A. Nicholson, the section on Physiography and Plant Distribution and that on Mosses and Liverworts were contributed by him. Whilst in Norwich the spread of *Azolla* interested him and he made valuable observations on this subject.

Since he came to Yorkshire Mr. Burrell has been known by naturalists chiefly as a bryologist, as his main interests were certainly centred in this group, but it was also recognized that as a general field botanist he was surpassed by few. According to his own statement his interest in the Bryophyta dated back to a request from E. M. Holmes, of the Museum of the Pharmaceutical Society, for some *Sphaerocarpus* which was known to have occurred in certain turnip fields in Norfolk and which Mr. Burrell successfully located. He soon acquired considerable skill and knowledge in connection with Bryophyta, and whilst still in Norfolk his insight enabled him to add to the records of the British Flora the hepatic *Lophozia Schultzii* var. *laxa* and the moss *Funaria hygrometrica* var. *arctica*.

Though not one of the foundation members of the Moss Exchange Club, which was formed in 1896, he must have been one of the early members, as in 1911 he served as the official distributor of this Club, which in 1922 gave birth to the British Bryological Society. Yorkshire Bryology gained much by Mr. Burrell's advent to this county with its rich bryological flora, and his influence in naturalist circles was soon evidenced by the periodic appearance of papers in 'The Naturalist', the official publication of the Yorkshire Naturalists' Union. In 1917 a paper appeared entitled "The Mosses and Liverworts of an Industrial City", which was a résumé of his presidential address to the Leeds Naturalists' Club in 1924; a paper on Pennine Peat embodied the results of years of careful systematic work. In 1940 there appeared a most interesting record of his research and observations on the distribution of the moss *Orthodontium gracile* var. *heterocarpum* Watson. The type of this species does not mature many

capsules in Yorkshire as they suffer from frost damage, but the variety fruits freely and would appear to be a more vigorous mutant which has established itself during the last fifty years in Cheshire and the neighbouring counties and still to be spreading rapidly. Such studies as these bear witness to the keenness of Mr. Burrell's powers of observation and the extreme care with which he made and recorded his observations—characteristics which undoubtedly account for his success and reliability as a bryologist. Both in the British Bryological Society and in the Yorkshire Naturalists' Union his opinion was frequently sought in critical cases of identification. Notwithstanding his expert knowledge, no one was more ready than Mr. Burrell to help beginners, and many bryologists probably owe their continued study of this group to the kindly encouragement that they received from him during the difficult initial stages of study.

In Leeds Mr. Burrell's ability was soon recognized by the late Professor J. H. Priestley, who in 1924 invited him to become the honorary curator of the Ingham Herbarium. This collection bequeathed to the University by William Ingham, comprised some 12,000 specimens of Bryophyta and included many valuable and well authenticated gatherings by bryologists of note and also a number of vouchers for county records. It was a labour of love for Mr. Burrell to examine and arrange these specimens, and later he was responsible for gathering together the various collections of plants belonging to the Department into the nucleus of a botanical museum. In this undertaking he took infinite trouble in visiting other museums to obtain advice as to the best methods on which to start the new museum. By 1937, when he relinquished the curatorship, he had put into good order a collection of flowering plants comprising some 2000 sheets of the old University collection, a large collection from John Cryer, some 40,000 sheets from the Ida Roper collection, as well as some 1,700 lichens from Dr. H. Sandstede and the Charophyta collected by Canon Bullock-Webster. He effected numerous exchanges with foreign museums, named and arranged many plants added by members of the staff of the Department, and also incorporated his own collection of Bryophyta and of fruits and seeds in the University collection. For this work no more suitable man than Mr. Burrell could have been found, and the University of Leeds owes deep gratitude to him—not only for the unsparing way in which he gave of his time and the great care and thoroughness with which this work was carried out, but also for the ever ready willingness with which he put his wide knowledge and experience at the disposal of the Botany Department to solve many extraneous problems.

As a man William Holmes Burrell was unassuming, kindly, and generous and possessed a certain strength of character that gave to all who came in contact with him a sense of safe reliance in the soundness of his judgment and opinions. His outstanding qualities lay perhaps in an essential honesty of outlook and deep sense of service. His great love of plants gave him an unfailing pleasure and interest in life which served to keep him to the end mentally vigorous and unfettered by his years. He was elected a Fellow of the Linnean Society on 6 June 1907.

LORNA I. SCOTT.

Mr. WALTER E. JAMES was a pharmacist with a wide range of interests and a keen desire to keep up to date in the pharmaceutical and medical fields. Recent advances in chemotherapy and the antibiotics attracted his attention, and a considerable proportion of his spare time was spent in reading the literature on these subjects.

The circumstances of war led him to take an active interest in the production of fine chemical substances, and it is typical of him that he used the opportunity to become an Associate of the Royal Institute of Chemistry. Nevertheless, Mr. James remained true to traditional pharmacy and retained his early and greater interest in the vegetable *materia medica*. He held a deep conviction that vegetable substances still had a great deal to offer to medicine and regretted that modern tendencies neglected this potentially valuable source of therapeutic material.

He had made pharmacognosy one of his major subjects, and his work in this field led him to become a Fellow of the Linnean Society.

Mr. James published frequently in a number of periodicals, both on technical subjects and on pharmaceutical politics, in which he took great interest. He also spent much time lecturing to pharmacists and to other groups.

His relations with his co-workers was always of the friendliest. He went out of his way to offer help where he thought necessary. He encouraged his associates to take an interest in their work and to study.

During his prolonged illness he was visited by a constant stream of fellow workers and other friends he had made in many spheres. He remained cheerful throughout and his death came as a shock even to those who knew him intimately.

J. T. MARSH.

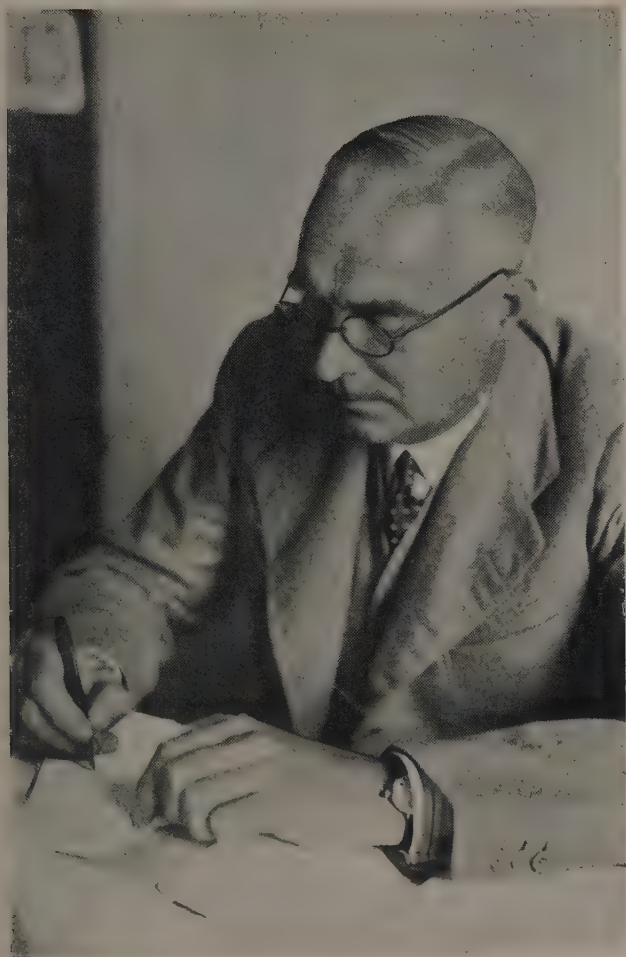
Dr. STANLEY WELLS KEMP, F.R.S., died on 16 May 1945. He was born in 1882, a son of Stephen Kemp, F.R.A.M., and was educated at St. Paul's School and Trinity College, Dublin. From a very early age he began to take a keen interest in Natural History. The St. Paul's School Field Club was instituted in June 1895, and from its inception Kemp, then only thirteen years old, played a considerable part in its activities: thus we find him exhibiting on 22 June of that year a vivarium well stocked with reptiles, and this interest he evidently retained, since in 1898 he read a paper before the Club on lizards and illustrated it with a cage-ful of most beautiful living specimens, both British and Foreign. In 1896 he exhibited a collection of more than twenty 'Skipper' butterflies, that he had caught at the previous Saturday's meeting of the Club at Wimbledon, and he later became Entomological Secretary of the Club and in 1899 their General Secretary. At that time he presented to the school Museum a collection of British butterflies, which has unfortunately been destroyed by enemy action during the war.

Kemp graduated at Trinity College, Dublin, in 1903, taking his B.A. degree with honours in Natural Science, gaining the place of Senior Moderator and being awarded a gold medal. At this time his chief biological interest seems to have centred mainly on the insects and especially on beetles and dragon-flies, an interest that he maintained throughout life. In the same year he joined the Fishery Branch of the

Department of Agriculture, Ireland, and thus began his career in Marine Biology. For the next few years he was fully occupied in trawling and tow-netting on the Atlantic Slope to the west of Ireland, down to 900 fathoms, and on the east side in the Irish Sea, or working in the floating laboratory in Ballenakill Harbour, Co., Galway. His first paper, published in 1905, dealt with the Echinoderms of this area, but he very soon became interested in the Crustacea and particularly in the large deep-sea prawns, and his next contribution to our knowledge was on the genus *Acanthephyra*: here already he showed promise of the meticulous accuracy and breadth of vision that characterized his later and more mature work. This paper was followed in 1910 by a Review of the Decapod Natantia of the coasts of Ireland. During his period of service with the Irish Fisheries he acquired a considerable and valuable experience of the methods then in use of obtaining collections of the deep-sea fauna and he was particularly impressed with the value of fine-meshed nets attached to the upper side of the Beam-trawl for securing the smaller organisms.

In 1910 Kemp left the Irish Fisheries on being appointed Senior Assistant Superintendent of the Zoological and Anthropological Section of the Indian Museum, Calcutta. On his arrival in India Kemp immediately took up the investigation of the Indian Decapoda, thus continuing the work which had already been begun by Mr. J. Wood-Mason and Lt.-Col. A. Alcock, I.M.S., and which had by then become almost a tradition of the Indian Museum. His researches are embodied in a series of papers in the Records of the Indian Museum entitled 'Notes on Decapoda Crustacea in the Indian Museum'; the first of these fundamental studies was published in 1910 and the seventeenth and last in 1925, a year after his retirement from India. In 1913 he published a Monograph on the Indo-Pacific Stomatopoda, which is a model of what such a monograph should be. It was the policy of the Trustees of the Indian Museum and of Dr. Annandale, then Superintendent of the Zoological and Anthropological Section of the Indian Museum, that the Officers of the Section should, if possible, spend a part of each year in the field, making collections and studying the fauna *in situ*: Kemp was thus able to visit a number of regions that were diverse in character and he thus laid the foundation of his knowledge of Zoology, which was quite exceptionally wide. In 1911 he carried out an expedition to the Kumaon Lakes in the lower ranges of the western Himalaya at altitudes ranging from 3,600 to 6,400 feet above sea-level, and in November of that year he accompanied the Abor Expedition to the north-east region of India, where Assam and Tibet meet. It was during the course of this expedition that he discovered and later described a new species of *Peripatus*, the first to be discovered in continental Asia, and which he named *Typhloperipatus williamsoni* gen. nov. et sp. nov.

On his return from this expedition in 1912, Kemp was appointed to act as Superintendent while Dr. Annandale was on leave, and he thus very early in his career gained valuable experience in the administration of a scientific department. His main interest, however, was in the marine fauna and in 1913 he paid a visit to the southern end of India and made collections on the coral reefs round Pamban and Rameswaram Islands and on the coast at Mandapam and Kilalarai. In 1914 he was



DR. STANLEY WELLS KEMP, F.R.S.

(Photograph taken in 1941.)

associated with Dr. Annandale in the investigation of the brackish-water fauna of the Chilka Lake in Orissa, India, and during the following year he paid his first visit to the Andaman Islands; he also investigated the fauna of the Matlah River and the Gangetic Delta and called attention to the extraordinary resemblance which many of the brackish-water species in that area bear to those inhabiting the depths of the sea, especially those that live at about 400 fathoms depth—a resemblance that affects not only bodily structure but also colour, especially obvious in the larger Crustacea—which he attributed mainly to convergence. In 1916 he paid a visit to the coast of Portuguese India on the west side of the Indian Peninsula.

Kemp possessed the happy knack of imparting his own enthusiasm for marine collecting to others and it was not long before he got into touch with some of the Hoogli River Pilots, whom he persuaded to take up trawling off the mouth of the river in their spare time while waiting on board the Pilot Steamer for the arrival of in-coming vessels which had to be piloted up to Calcutta, and this resulted in the acquisition of a number of interesting specimens from this area.

Within a short time of his arrival in India Kemp joined the Asiatic Society of Bengal. He was appointed a Member of Council of the Society in 1912 and 1913, and during the latter part of this year he officiated as its General Secretary. In the same year he was elected a Fellow of the Society and also a Fellow of Calcutta University. In 1914 he served on the Library Committee of the Society and during 1915 and 1916 he was Honorary Librarian. In 1917 he was again appointed a Member of Council and continued to act as Librarian. During this year he somehow managed to find time to compile a Catalogue of the Serial Scientific Publications that were available in the various libraries in Calcutta: this Catalogue contains references to more than 3,000 volumes in twenty different libraries and it is of the greatest assistance to anyone who is engaged in scientific research.

In 1916 the Zoological and Anthropological Section of the Indian Museum was reconstituted as a separate department with the title of 'The Zoological Survey of India', under the Directorship of Dr. N. Annandale, and Kemp was appointed Superintendent. In 1918 Dr. Annandale offered, and the Government of India accepted, the services of the Zoological Survey for an extensive investigation into the Mollusc Fauna of India, with a view to discovering whether any Indian mollusc could act as a host to the parasitic Trematode, *Schistosoma*, which was unknown as a human parasite in India. The war of 1914–18 was coming to an end and it was known that many of the Indian troops who were serving overseas had become infected with this parasite and it was feared that on being repatriated they might introduce it: in consequence, in August, 1918, Kemp visited the region of Secunderabad and Hyderabad in South India and in November he accompanied Dr. Annandale on an expedition into Seistan and Baluchistan. At the same time Kemp began an enquiry into the Cercariae that occur in Indian Molluscs, but he relinquished this work when he proceeded on leave to England in May, 1919. While on leave Kemp married Agnes, daughter of the Rev. W. Spotswood Green. In that year he was awarded the degree of Sc.D. by his old College, Trinity College, Dublin. During this period he was

placed on special duty by the India Office to visit some of the centres of Zoological Research in Europe with a view to formulating a plan for the establishment of a Marine Biological Station in India. On his return from leave Kemp duly submitted his scheme for such a station in the Andaman Islands and this was approved by the Government of India, but financial considerations prevented its execution and in spite of recommendations sent to the Government in subsequent years by the Director of the Zoological Survey of India and the Indian Science Congress, India is still without this important development. During the next two or three years Kemp again acted as Biological Secretary of the Asiatic Society of Bengal, and in addition he served on the Building and the Publication Committees; and in 1922 he again acted as Honorary Librarian. In 1921 he revisited the Andaman Islands and continued his studies of the coral-reef fauna; in 1922 he carried out an expedition to explore the Siju Cave in the Garo Hills, Assam.

In 1924 Dr. Annandale, the Director of the Zoological Survey of India, died and Kemp was appointed by the Government of India to officiate as Director, but six weeks later he retired from the Zoological Survey to take up his appointment as Director of the 'Discovery' Expedition to the Antarctic and so after fourteen years, during which he had contributed very largely to our knowledge of the Indian Crustacea and had built up a reputation as a first-class systematist, he severed his connection with the Indian Museum.

In 1927, the Royal Asiatic Society of Bengal showed their appreciation of the value of his work in India by awarding him the Berkeley Memorial Medal.

An account of his activities during the next twelve years must include a brief explanation of the origin and scope of the 'Discovery' Investigations, for it devolved upon him to execute the programme under the general direction of the 'Discovery' Committee. This Committee was appointed in 1923 by the Secretary of State for the Colonies, primarily for 'research and development' in Dependencies of the Falkland Islands. At that time the Dependencies were the principal centre of the whaling industry, and the investigations were to be focussed largely on whales. The work however was planned on very broad lines, and was to include research on the oceanic environment of the whales and other fauna. This could not be confined to the waters of the Dependencies, especially when, later on, the use of factory ships enabled the industry to spread over the open expanses of the Southern Ocean. A general oceanographic survey of the Southern Ocean was thus involved, and it was arranged also that coastal surveys and soundings, observations on the distribution of sea-ice, investigations on fish, seals, etc., general collections of the fauna and flora, and various subsidiary observations (geology, meteorology, etc.) should, as far as possible, be included in the work. Kemp was appointed Director of Research in June 1924, and although he had the general guidance of an expert committee, the initial organization of this complex programme depended very largely on his special administrative capacity. Under his leadership the methods of research were founded to some extent on the general principles of fisheries research, on the experience gained by the 'Challenger' expedition and various Antarctic expeditions, on Admiralty surveying methods, etc., but much

of the work was quite new, and to weld the different lines of research into a co-ordinated programme was a task which called for considerable creative ability. Furthermore, in such expeditions (where work and living conditions are interdependent) the design of the ships, the technical equipment, the personalities of the staff, and even the provision of the necessities of life have to be taken most carefully into account in the organization of the research. Those who worked with Kemp in the early days of preparation will remember his room in the Colonial Office, the tables and floor piled high with files, catalogues and charts, and with samples of an immense variety of equipment ranging from sea boots to microscopes. Messengers hurried in and out, the telephone was seldom quiet, and the impression was one of constant bustle and confusion. One soon realized, however, that Kemp had everything well in hand down to the smallest detail, and that he had the faculty of working fast and accurately. Occasionally he would take a taxi, visit half a dozen firms, and be back in the office within an hour. Yet his manner was unhurried and he always had time for calm and thoughtful consideration of any question which was presented to him.

Work in the field was begun in February 1925, at the Marine Biological Station at South Georgia where direct observations were continued until 1931 on the external characters, food, breeding, growth, etc., of the whales brought in to the local whaling station. Work on seals and local hydrology was also included. In the meantime Scott's old ship, the 'Discovery', purchased from the Hudson's Bay Co., was being refitted for oceanographic research, and Kemp sailed in her from England later in 1925. Her commission lasted for two years during which plankton and hydrology were studied in lines of stations across parts of the Atlantic sector and intensively on the South Georgia whaling grounds. The South Shetland Islands and Palmer Archipelago were visited and much experience was gained for the guidance of future research. The 'smaller ship, the 'William Scoresby', sailed in 1926 and her work at first included experimental whale-marking, general oceanography in conjunction with the 'Discovery', and experimental trawling on the vast continental shelf between the Falkland Islands and Patagonia. In 1929 the 'Discovery' was chartered to the Australian Government, and plans were made for the building of the 'Discovery II'. Kemp was responsible for the scientific equipment of this ship and, in a large degree, for her design; and it is mainly owing to him that the 'Discovery II' has been found almost perfectly suited to long range oceanographic research, and most adaptable as an all-round research ship.

The 'Discovery II' sailed on her first commission at the end of 1929, with Kemp on board. The programme was to some extent similar to that of the 'Discovery', but with the greater speed and range of the 'Discovery II' the work was far more extensive and thorough. Intensive oceanographic surveys of the principal whaling grounds were made, the waters of the Dependencies and other parts of the Atlantic sector were covered by lines of stations, other lines were run out across the main current systems off Capetown and Durban, a running survey was made of the S. Sandwich Islands, and the commission ended with a long line of deep stations in 30°W from 57°S to 15°N which provided a valuable vertical section of a large part of the Atlantic. Kemp took a particular

interest in the technique of oceanography, and much of the gear used was of his own design. While the ship was at work on station his tall figure was nearly always to be seen about the deck, watching the angle of the wires and the motion of the ship, inspecting the net samples, and ever ready with a remedy for any hitch. He never showed a trace of sea-sickness in the most appalling weather and his composure was never ruffled in the most trying circumstances.

The first commission of the 'Discovery II' ended in 1931. Kemp did not go to sea again, but he organized further commissions by the 'Discovery II' (1931-3, 1933-5, etc.) in which the work was extended round the whole Southern Ocean. The ship usually sailed from England in the autumn and was absent for about twenty months. At least a month was devoted to coastal surveys in the Dependencies, there was a break for a refit, usually at Simonstown, and the rest of the time was occupied mainly in the open ocean.

The 'William Scoresby' in the meanwhile had carried out oceanographic work in the Dependencies, further trawling surveys, and (at the request of the Admiralty) a survey of the Peru coastal current; from 1934 onwards she was exclusively engaged in the marking of whales.

In addition to the general supervision of these expeditions Kemp was occupied at home in arrangements for working out and publishing the results of the investigations. He was anxious that the reports should be published in the best style and took much trouble in choosing suitable paper and establishing a high standard for the illustrations. The first volume of the 'Discovery' Reports was published in 1929. As a systematic zoologist he took a great interest in the large collections of marine fauna which were accumulating, for it had been possible to use a considerable variety of nets and other collecting gear and to obtain plankton and benthos from a great range of depths and latitudes. His own interest lay especially in the deep sea prawns. In the latter years of his life administrative work left him little time for private research, but he had assembled a representative collection of these prawns from the 'Discovery' material and other sources, and was preparing a paper on their vertical and horizontal distribution. Unfortunately his notes were lost when the Plymouth Laboratory was damaged during air raids in the early years of the war.

In 1928 Kemp became a Fellow of both the Zoological Society and the Linnean Society, and in 1933 was elected a member of Council of the latter Society and became its Zoological Secretary, a post that he filled most admirably till 1936, when he gave up the appointment on becoming Director of the Marine Biological Laboratory at Plymouth and Secretary to the Marine Biological Association of the United Kingdom, in succession to Dr. Allen. In 1931 Kemp was elected a Fellow of the Royal Society of London, and within a very short time began to take an active part in the affairs of the Society. He served on the Council in 1935 and 1936, and was a member of a number of Committees. He was on the Zoological Committee in 1934 and 1935, and the Biological Expeditions Committee between 1935 and 1938; at the time of his death he was a member of the Pacific Science Committee, having first joined it in 1934, the Browne Research Committee which he had joined in 1938, and was Chairman of the Bermuda Oceanographic Committee, having been its Secretary from 1936 to 1941.

In 1936 Kemp was appointed to the post of Director of the Marine Biological Laboratory, Plymouth, and took up the appointment on 1 October. During the first three years of his work at Plymouth Kemp made efforts to increase the income and the Membership of the Association; this work was largely crowned with success, the membership being increased during the year 1939-40 by sixty-six new members, as contrasted with an average of fifteen new members per annum during the preceding three years. Important additions and renovations were carried out in the Laboratory, including the reconstruction and furnishing of the 1st floor; but all this work was undone in 1941 when the Laboratory and Dr. Kemp's residence were badly damaged as a result of a combined high-explosive and incendiary raid. One of the H.E. bombs destroyed the water-main, while others damaged the laboratory, and an incendiary bomb fell on the Director's house and set it on fire; owing to the lack of water the fire got out of control and the house and practically the whole of its contents were destroyed.

In 1943-44 Kemp was consulted by the Colonial Office regarding Fishery problems in different parts of the Empire, and he was invited to discuss Fishery questions with the Colonial Research Committee: he was thus able to help in drawing up plans for Post-war Research and Development in our Colonial Fisheries. In October 1944 the Secretary of State for India invited Kemp to go out to that country to advise the Government on the organisation and development of the Indian Marine Fisheries. Although he was unable to accept the invitation he managed to find time to draw up a complete memorandum on the subject; he also forwarded a comprehensive scheme for Fishery Investigations in Bengal to one of his former colleagues in the Zoological Survey of India, Dr. S. L. Hora, who had been appointed Director of Fisheries in that Province.

The future development and well being of the Plymouth Laboratory was a subject dear to Kemp's heart and he has left plans for the Laboratory of the future. He had also hoped to see a revival of deep-sea biological work after the war, and was particularly anxious that there should be a deep-water biological expedition to investigate the bottom fauna and biological conditions generally in the area to the west of Ireland, where he had begun his marine studies over forty years ago. As already mentioned, one of his interests in early life had been the study of Coleoptera and this remained a life-long hobby. He was at times to be seen collecting at Wicken Fen, and in his last days near Ivybridge, he was actively following up problems of distribution of various species on Dartmoor.

Although Kemp achieved a leading position in Marine Biological Science he was also a great Naturalist, and was always ready to put his knowledge and sound judgement at the service of any *bona fide* student who cared to consult him: he had, however, an almost exaggerated dislike of anything that savoured of self-advertisement and in consequence his mental stature was perhaps not fully appreciated except by those who came into personal contact with him. By his death the Linnean Society has lost a true friend and a distinguished Fellow, and we extend our deepest sympathy to his widow and his daughter.

R. B. SEYMOUR SEWELL
N. A. MACKINTOSH.

[Part 2. pp. 71-119, published 23 May 1946.]

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